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(54) Title: CORYNEBACTERIUM GLUTAMICUM GENES ENCODING STRESS, RESISTANCE AND TOLERANCE PROTEINS

(57) Abstract: Isolated nucleic acid molecules, designated SRT nucleic acid molecules, which encode novel SRT proteins from *Corynebacterium glutamicum* are described. The invention also provides antisense nucleic acid molecules, recombinant expression vectors containing SRT nucleic acid molecules, and host cells into which the expression vectors have been introduced. The invention still further provides isolated SRT proteins, mutated SRT proteins, fusion proteins, antigenic peptides and methods for the improvement of production of a desired compound from *C. glutamicum* based on genetic engineering of SRT genes in this organism.

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***CORYNEBACTERIUM GLUTAMICUM* GENES ENCODING STRESS,
RESISTANCE AND TOLERANCE PROTEINS**

Related Applications

5 This application claims priority to prior filed U.S. Provisional Patent Application Serial No. 60/141031, filed June 25, 1999, U.S. Provisional Patent Application Serial No. 60/142692, filed July 1, 1999, and also to U.S. Provisional Patent Application Serial No. 60/151214, filed August 27, 1999. This application also claims priority to German Patent Application No. 19930429.7, filed July 1, 1999, German Patent Application No. 10 19931413.6, filed July 8, 1999, German Patent Application No. 19931457.8, filed July 8, 1999, German Patent Application No. 19931541.8, filed July 8, 1999, German Patent Application No. 19932209.0, filed July 9, 1999, German Patent Application No. 19932230.9, filed July 9, 1999, German Patent Application No. 19932914.1, filed July 14, 1999, German Patent Application No. 19940764.9, filed August 27, 1999, and 15 German Patent Application No. 19941382.7, filed August 31, 1999. The entire contents of all of the aforementioned applications are hereby expressly incorporated herein in their entirety by this reference.

Background of the Invention

20 Certain products and by-products of naturally-occurring metabolic processes in cells have utility in a wide array of industries, including the food, feed, cosmetics, and pharmaceutical industries. These molecules, collectively termed 'fine chemicals', include organic acids, both proteinogenic and non-proteinogenic amino acids, nucleotides and nucleosides, lipids and fatty acids, diols, carbohydrates, aromatic 25 compounds, vitamins and cofactors, and enzymes. Their production is most conveniently performed through large-scale culture of bacteria developed to produce and secrete large quantities of a particular desired molecule. One particularly useful organism for this purpose is *Corynebacterium glutamicum*, a gram positive, nonpathogenic bacterium. Through strain selection, a number of mutant strains have 30 been developed which produce an array of desirable compounds. However, selection of strains improved for the production of a particular molecule is a time-consuming and difficult process.

Summary of the Invention

The invention provides novel bacterial nucleic acid molecules which have a variety of uses. These uses include the identification of microorganisms which can be used to produce fine chemicals, the modulation of fine chemical production in *C. glutamicum* or related bacteria, the typing or identification of *C. glutamicum* or related bacteria, as reference points for mapping the *C. glutamicum* genome, and as markers for transformation. These novel nucleic acid molecules encode proteins, referred to herein as stress, resistance and tolerance (SRT) proteins.

C. glutamicum is a gram positive, aerobic bacterium which is commonly used in industry for the large-scale production of a variety of fine chemicals, and also for the degradation of hydrocarbons (such as in petroleum spills) and for the oxidation of terpenoids. The SRT nucleic acid molecules of the invention, therefore, can be used to identify microorganisms which can be used to produce fine chemicals, *e.g.*, by fermentation processes. Modulation of the expression of the SRT nucleic acids of the invention, or modification of the sequence of the SRT nucleic acid molecules of the invention, can be used to modulate the production of one or more fine chemicals from a microorganism (*e.g.*, to improve the yield or production of one or more fine chemicals from a *Corynebacterium* or *Brevibacterium* species).

The SRT nucleic acids of the invention may also be used to identify an organism as being *Corynebacterium glutamicum* or a close relative thereof, or to identify the presence of *C. glutamicum* or a relative thereof in a mixed population of microorganisms. The invention provides the nucleic acid sequences of a number of *C. glutamicum* genes; by probing the extracted genomic DNA of a culture of a unique or mixed population of microorganisms under stringent conditions with a probe spanning a region of a *C. glutamicum* gene which is unique to this organism, one can ascertain whether this organism is present. Although *Corynebacterium glutamicum* itself is nonpathogenic, it is related to species pathogenic in humans, such as *Corynebacterium diphtheriae* (the causative agent of diphtheria); the detection of such organisms is of significant clinical relevance.

The SRT nucleic acid molecules of the invention may also serve as reference points for mapping of the *C. glutamicum* genome, or of genomes of related organisms.

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Similarly, these molecules, or variants or portions thereof, may serve as markers for genetically engineered *Corynebacterium* or *Brevibacterium* species.

The SRT proteins encoded by the novel nucleic acid molecules of the invention are capable of, for example, permitting *C. glutamicum* to survive in a setting which is
5 either chemically or environmentally hazardous to this microorganism. Given the availability of cloning vectors for use in *Corynebacterium glutamicum*, such as those disclosed in Sinskey *et al.*, U.S. Patent No. 4,649,119, and techniques for genetic manipulation of *C. glutamicum* and the related *Brevibacterium* species (*e.g.*, *lactofermentum*) (Yoshihama *et al.*, *J. Bacteriol.* 162: 591-597 (1985); Katsumata *et al.*,
10 *J. Bacteriol.* 159: 306-311 (1984); and Santamaria *et al.*, *J. Gen. Microbiol.* 130: 2237-2246 (1984)), the nucleic acid molecules of the invention may be utilized in the genetic engineering of this organism to make it a better or more efficient producer of one or more fine chemicals, through the ability of these proteins to permit growth and multiplication of *C. glutamicum* (and also continuous production of one or more fine
15 chemicals) under circumstances which would normally impede growth of the organism, such as those conditions frequently encountered during large-scale fermentative growth. For example, by overexpressing or engineering a heat-shock induced protease molecule such that it is optimized in activity, one may increase the ability of the bacterium to degrade incorrectly folded proteins when the bacterium is challenged with high
20 temperatures. By having fewer misfolded (and possibly misregulated or nonfunctional) proteins to interfere with normal reaction mechanisms in the cell, the cell is increased in its ability to function normally in such a culture, which should in turn provide increased viability. This overall increase in number of cells having greater viability and activity in the culture should also result in an increase in yield, production, and/or efficiency of
25 production of one or more desired fine chemicals, due at least to the relatively greater number of cells producing these chemicals in the culture.

This invention provides novel SRT nucleic acid molecules which encode SRT proteins which are capable of, for example, permitting *C. glutamicum* to survive in a setting which is either chemically or environmentally hazardous to this microorganism.
30 Nucleic acid molecules encoding an SRT protein are referred to herein as SRT nucleic acid molecules. In a preferred embodiment, the SRT protein participates in metabolic pathways permitting *C. glutamicum* to survive in a setting which is either chemically or

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environmentally hazardous to this microorganism. Examples of such proteins include those encoded by the genes set forth in Table 1.

Accordingly, one aspect of the invention pertains to isolated nucleic acid molecules (*e.g.*, cDNAs, DNAs, or RNAs) comprising a nucleotide sequence encoding
5 an SRT protein or biologically active portions thereof, as well as nucleic acid fragments suitable as primers or hybridization probes for the detection or amplification of SRT-encoding nucleic acid (*e.g.*, DNA or mRNA). In particularly preferred embodiments, the isolated nucleic acid molecule comprises one of the nucleotide sequences set forth as the odd-numbered SEQ ID NOs in the Sequence Listing (*e.g.*, SEQ ID NO:1, SEQ ID
10 NO:3, SEQ ID NO:5, SEQ ID NO:7....), or the coding region or a complement thereof of one of these nucleotide sequences. In other particularly preferred embodiments, the isolated nucleic acid molecule of the invention comprises a nucleotide sequence which hybridizes to or is at least about 50%, preferably at least about 60%, more preferably at least about 70%, 80% or 90%, and even more preferably at least about 95%, 96%, 97%,
15 98%, 99% or more homologous to a nucleotide sequence set forth as an odd-numbered SEQ ID NO in the Sequence Listing (*e.g.*, SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7....), or a portion thereof. In other preferred embodiments, the isolated nucleic acid molecule encodes one of the amino acid sequences set forth as an even-numbered SEQ ID NO in the Sequence Listing (*e.g.*, SEQ ID NO:2, SEQ ID NO:4, SEQ
20 ID NO:6, SEQ ID NO:8....). The preferred SRT proteins of the present invention also preferably possess at least one of the SRT activities described herein.

In another embodiment, the isolated nucleic acid molecule encodes a protein or portion thereof wherein the protein or portion thereof includes an amino acid sequence which is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a
25 sequence having an even-numbered SEQ ID NO: in the Sequence Listing), *e.g.*, sufficiently homologous to an amino acid sequence of the invention such that the protein or portion thereof maintains an SRT activity. Preferably, the protein or portion thereof encoded by the nucleic acid molecule maintains the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this
30 microorganism. In one embodiment, the protein encoded by the nucleic acid molecule is at least about 50%, preferably at least about 60%, and more preferably at least about 70%, 80%, or 90% and most preferably at least about 95%, 96%, 97%, 98%, or 99% or

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more homologous to an amino acid sequence of the invention (*e.g.*, an entire amino acid sequence selected from those having an even-numbered SEQ ID NO in the Sequence Listing). In another preferred embodiment, the protein is a full length *C. glutamicum* protein which is substantially homologous to an entire amino acid sequence of the invention (encoded by an open reading frame shown the corresponding odd-numbered
5 SEQ ID NOs in the Sequence Listing (*e.g.*, SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7...)).

In another preferred embodiment, the isolated nucleic acid molecule is derived from *C. glutamicum* and encodes a protein (*e.g.*, an SRT fusion protein) which includes
10 a biologically active domain which is at least about 50% or more homologous to one of the amino acid sequences of the invention (*e.g.*, a sequence of one of the even-numbered SEQ ID NOs in the Sequence Listing) and has the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism, or possesses one or more of the activities set forth in Table 1, and which
15 also includes heterologous nucleic acid sequences encoding a heterologous polypeptide or regulatory regions.

In another embodiment, the isolated nucleic acid molecule is at least 15 nucleotides in length and hybridizes under stringent conditions to a nucleic acid molecule comprising a nucleotide sequence of the invention (*e.g.*, a sequence of an odd-
20 numbered SEQ ID NO in the Sequence Listing). Preferably, the isolated nucleic acid molecule corresponds to a naturally-occurring nucleic acid molecule. More preferably, the isolated nucleic acid encodes a naturally-occurring *C. glutamicum* SRT protein, or a biologically active portion thereof.

Another aspect of the invention pertains to vectors, *e.g.*, recombinant expression
25 vectors, containing the nucleic acid molecules of the invention, and host cells into which such vectors have been introduced. In one embodiment, such a host cell is used to produce an SRT protein by culturing the host cell in a suitable medium. The SRT protein can be then isolated from the medium or the host cell.

Yet another aspect of the invention pertains to a genetically altered
30 microorganism in which an SRT gene has been introduced or altered. In one embodiment, the genome of the microorganism has been altered by the introduction of a nucleic acid molecule of the invention encoding wild-type or mutated SRT sequence as

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a transgene. In another embodiment, an endogenous SRT gene within the genome of the microorganism has been altered, *e.g.*, functionally disrupted, by homologous recombination with an altered SRT gene. In another embodiment, an endogenous or introduced SRT gene in a microorganism has been altered by one or more point mutations, deletions, or inversions, but still encodes a functional SRT protein. In still another embodiment, one or more of the regulatory regions (*e.g.*, a promoter, repressor, or inducer) of a SRT gene in a microorganism has been altered (*e.g.*, by deletion, truncation, inversion, or point mutation) such that the expression of the SRT gene is modulated. In a preferred embodiment, the microorganism belongs to the genus *Corynebacterium* or *Brevibacterium*, with *Corynebacterium glutamicum* being particularly preferred. In a preferred embodiment, the microorganism is also utilized for the production of a desired compound, such as an amino acid, with lysine being particularly preferred.

In another aspect, the invention provides a method of identifying the presence or activity of *Corynebacterium diphtheriae* in a subject. This method includes detection of one or more of the nucleic acid or amino acid sequences of the invention (*e.g.*, the sequences set forth in the Sequence Listing as SEQ ID NOs 1 through 304)) in a subject, thereby detecting the presence or activity of *Corynebacterium diphtheriae* in the subject.

Still another aspect of the invention pertains to an isolated SRT protein or a portion, *e.g.*, a biologically active portion, thereof. In a preferred embodiment, the isolated SRT protein or portion thereof possesses the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism. In another preferred embodiment, the isolated SRT protein or portion thereof is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: in the Sequence Listing) such that the protein or portion thereof maintains the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism.

The invention also provides an isolated preparation of an SRT protein. In preferred embodiments, the SRT protein comprises an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of the Sequence Listing). In another preferred embodiment, the invention pertains to an isolated full length protein

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which is substantially homologous to an entire amino acid sequence of the invention (e.g., a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) (encoded by an open reading frame set forth in a corresponding odd-numbered SEQ ID NO: of the Sequence Listing).). In yet another embodiment, the protein is at least about 50%,
5 preferably at least about 60%, and more preferably at least about 70%, 80%, or 90%, and most preferably at least about 95%, 96%, 97%, 98%, or 99% or more homologous to an entire amino acid sequence of the invention (e.g., a sequence of an even-numbered SEQ ID NO: of the Sequence Listing). In other embodiments, the isolated SRT protein comprises an amino acid sequence which is at least about 50% or more homologous to
10 one of the amino acid sequences of the invention (e.g., a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) and is able to improve the survival rate of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism, or has one or more of the activities set forth in Table 1.

Alternatively, the isolated SRT protein can comprise an amino acid sequence
15 which is encoded by a nucleotide sequence which hybridizes, e.g., hybridizes under stringent conditions, or is at least about 50%, preferably at least about 60%, more preferably at least about 70%, 80%, or 90%, and even more preferably at least about 95%, 96%, 97%, 98%, or 99% or more homologous to a nucleotide sequence of one of the even-numbered SEQ ID NOs set forth in the Sequence Listing. It is also preferred
20 that the preferred forms of SRT proteins also have one or more of the SRT bioactivities described herein.

The SRT polypeptide, or a biologically active portion thereof, can be operatively linked to a non-SRT polypeptide to form a fusion protein. In preferred embodiments, this fusion protein has an activity which differs from that of the SRT protein alone. In
25 other preferred embodiments, this fusion protein results in increased yields, production, and/or efficiency of production of a desired fine chemical from *C. glutamicum*. In particularly preferred embodiments, integration of this fusion protein into a host cell modulates the production of a desired compound from the cell.

In another aspect, the invention provides methods for screening molecules which
30 modulate the activity of an SRT protein, either by interacting with the protein itself or a substrate or binding partner of the SRT protein, or by modulating the transcription or translation of an SRT nucleic acid molecule of the invention.

Another aspect of the invention pertains to a method for producing a fine chemical. This method involves the culturing of a cell containing a vector directing the expression of an SRT nucleic acid molecule of the invention, such that a fine chemical is produced. In a preferred embodiment, this method further includes the step of obtaining
5 a cell containing such a vector, in which a cell is transfected with a vector directing the expression of an SRT nucleic acid. In another preferred embodiment, this method further includes the step of recovering the fine chemical from the culture. In a particularly preferred embodiment, the cell is from the genus *Corynebacterium* or *Brevibacterium*, or is selected from those strains set forth in Table 3.

10 Another aspect of the invention pertains to methods for modulating production of a molecule from a microorganism. Such methods include contacting the cell with an agent which modulates SRT protein activity or SRT nucleic acid expression such that a cell associated activity is altered relative to this same activity in the absence of the agent. In a preferred embodiment, the cell is modulated in resistance to one or more
15 toxic chemicals or in resistance to one or more environmental stresses, such that the yields or rate of production of a desired fine chemical by this microorganism is improved. The agent which modulates SRT protein activity can be an agent which stimulates SRT protein activity or SRT nucleic acid expression. Examples of agents which stimulate SRT protein activity or SRT nucleic acid expression include small
20 molecules, active SRT proteins, and nucleic acids encoding SRT proteins that have been introduced into the cell. Examples of agents which inhibit SRT activity or expression include small molecules, and antisense SRT nucleic acid molecules.

Another aspect of the invention pertains to methods for modulating yields of a desired compound from a cell, involving the introduction of a wild-type or mutant SRT
25 gene into a cell, either maintained on a separate plasmid or integrated into the genome of the host cell. If integrated into the genome, such integration can random, or it can take place by homologous recombination such that the native gene is replaced by the introduced copy, causing the production of the desired compound from the cell to be modulated. In a preferred embodiment, said yields are increased. In another preferred
30 embodiment, said chemical is a fine chemical. In a particularly preferred embodiment, said fine chemical is an amino acid. In especially preferred embodiments, said amino acid is L-lysine.

Detailed Description of the Invention

The present invention provides SRT nucleic acid and protein molecules which are involved in the survival of *C. glutamicum* upon exposure of this microorganism to chemical or environmental hazards. The molecules of the invention may be utilized in the modulation of production of fine chemicals from microorganisms, since these SRT proteins provide a means for continued growth and multiplication of *C. glutamicum* in the presence of toxic chemicals or hazardous environmental conditions, such as may be encountered during large-scale fermentative growth. By increasing the growth rate or at least maintaining normal growth in the face of poor, if not toxic, conditions, one may increase the yield, production, and/or efficiency of production of one or more fine chemicals from such a culture, at least due to the relatively greater number of cells producing the fine chemical in the culture. Aspects of the invention are further explicated below.

15 I. Fine Chemicals

The term 'fine chemical' is art-recognized and includes molecules produced by an organism which have applications in various industries, such as, but not limited to, the pharmaceutical, agriculture, and cosmetics industries. Such compounds include organic acids, such as tartaric acid, itaconic acid, and diaminopimelic acid, both proteinogenic and non-proteinogenic amino acids, purine and pyrimidine bases, nucleosides, and nucleotides (as described *e.g.* in Kuninaka, A. (1996) Nucleotides and related compounds, p. 561-612, in Biotechnology vol. 6, Rehm *et al.*, eds. VCH: Weinheim, and references contained therein), lipids, both saturated and unsaturated fatty acids (*e.g.*, arachidonic acid), diols (*e.g.*, propane diol, and butane diol), carbohydrates (*e.g.*, hyaluronic acid and trehalose), aromatic compounds (*e.g.*, aromatic amines, vanillin, and indigo), vitamins and cofactors (as described in Ullmann's Encyclopedia of Industrial Chemistry, vol. A27, "Vitamins", p. 443-613 (1996) VCH: Weinheim and references therein; and Ong, A.S., Niki, E. & Packer, L. (1995) "Nutrition, Lipids, Health, and Disease" Proceedings of the UNESCO/Confederation of Scientific and Technological Associations in Malaysia, and the Society for Free Radical Research – Asia, held Sept. 1-3, 1994 at Penang, Malaysia, AOCS Press, (1995)), enzymes, polyketides (Cane *et al.* (1998) *Science* 282: 63-68), and all other chemicals described in

Gutcho (1983) *Chemicals by Fermentation*, Noyes Data Corporation, ISBN: 0818805086 and references therein. The metabolism and uses of certain of these fine chemicals are further explicated below.

5 A. *Amino Acid Metabolism and Uses*

Amino acids comprise the basic structural units of all proteins, and as such are essential for normal cellular functioning in all organisms. The term "amino acid" is art-recognized. The proteinogenic amino acids, of which there are 20 species, serve as structural units for proteins, in which they are linked by peptide bonds, while the
10 nonproteinogenic amino acids (hundreds of which are known) are not normally found in proteins (see Ulmann's Encyclopedia of Industrial Chemistry, vol. A2, p. 57-97 VCH: Weinheim (1985)). Amino acids may be in the D- or L- optical configuration, though L-amino acids are generally the only type found in naturally-occurring proteins. Biosynthetic and degradative pathways of each of the 20 proteinogenic amino acids
15 have been well characterized in both prokaryotic and eukaryotic cells (see, for example, Stryer, L. Biochemistry, 3rd edition, pages 578-590 (1988)). The 'essential' amino acids (histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine), so named because they are generally a nutritional requirement due to the complexity of their biosyntheses, are readily converted by simple biosynthetic pathways.
20 to the remaining 11 'nonessential' amino acids (alanine, arginine, asparagine, aspartate, cysteine, glutamate, glutamine, glycine, proline, serine, and tyrosine). Higher animals do retain the ability to synthesize some of these amino acids, but the essential amino acids must be supplied from the diet in order for normal protein synthesis to occur.

Aside from their function in protein biosynthesis, these amino acids are
25 interesting chemicals in their own right, and many have been found to have various applications in the food, feed, chemical, cosmetics, agriculture, and pharmaceutical industries. Lysine is an important amino acid in the nutrition not only of humans, but also of monogastric animals such as poultry and swine. Glutamate is most commonly used as a flavor additive (mono-sodium glutamate, MSG) and is widely used throughout
30 the food industry, as are aspartate, phenylalanine, glycine, and cysteine. Glycine, L-methionine and tryptophan are all utilized in the pharmaceutical industry. Glutamine, valine, leucine, isoleucine, histidine, arginine, proline, serine and alanine are of use in

both the pharmaceutical and cosmetics industries. Threonine, tryptophan, and D/ L-methionine are common feed additives. (Leuchtenberger, W. (1996) Amino acids – technical production and use, p. 466-502 in Rehm *et al.* (eds.) Biotechnology vol. 6, chapter 14a, VCH: Weinheim). Additionally, these amino acids have been found to be
5 useful as precursors for the synthesis of synthetic amino acids and proteins, such as N-acetylcysteine, S-carboxymethyl-L-cysteine, (S)-5-hydroxytryptophan, and others described in Ulmann's Encyclopedia of Industrial Chemistry, vol. A2, p. 57-97, VCH: Weinheim, 1985.

The biosynthesis of these natural amino acids in organisms capable of
10 producing them, such as bacteria, has been well characterized (for review of bacterial amino acid biosynthesis and regulation thereof, see Umbarger, H.E.(1978) *Ann. Rev. Biochem.* 47: 533-606). Glutamate is synthesized by the reductive amination of α -ketoglutarate, an intermediate in the citric acid cycle. Glutamine, proline, and arginine are each subsequently produced from glutamate. The biosynthesis of serine is a three-
15 step process beginning with 3-phosphoglycerate (an intermediate in glycolysis), and resulting in this amino acid after oxidation, transamination, and hydrolysis steps. Both cysteine and glycine are produced from serine; the former by the condensation of homocysteine with serine, and the latter by the transferal of the side-chain β -carbon atom to tetrahydrofolate, in a reaction catalyzed by serine transhydroxymethylase.
20 Phenylalanine, and tyrosine are synthesized from the glycolytic and pentose phosphate pathway precursors erythrose 4-phosphate and phosphoenolpyruvate in a 9-step biosynthetic pathway that differ only at the final two steps after synthesis of prephenate. Tryptophan is also produced from these two initial molecules, but its synthesis is an 11-
step pathway. Tyrosine may also be synthesized from phenylalanine, in a reaction
25 catalyzed by phenylalanine hydroxylase. Alanine, valine, and leucine are all biosynthetic products of pyruvate, the final product of glycolysis. Aspartate is formed from oxaloacetate, an intermediate of the citric acid cycle. Asparagine, methionine, threonine, and lysine are each produced by the conversion of aspartate. Isoleucine is formed from threonine. A complex 9-step pathway results in the production of histidine
30 from 5-phosphoribosyl-1-pyrophosphate, an activated sugar.

Amino acids in excess of the protein synthesis needs of the cell cannot be stored, and are instead degraded to provide intermediates for the major metabolic pathways of

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the cell (for review see Stryer, L. Biochemistry 3rd ed. Ch. 21 "Amino Acid Degradation and the Urea Cycle" p. 495-516 (1988)). Although the cell is able to convert unwanted amino acids into useful metabolic intermediates, amino acid production is costly in terms of energy, precursor molecules, and the enzymes necessary to synthesize them.

5 Thus it is not surprising that amino acid biosynthesis is regulated by feedback inhibition, in which the presence of a particular amino acid serves to slow or entirely stop its own production (for overview of feedback mechanisms in amino acid biosynthetic pathways, see Stryer, L. Biochemistry, 3rd ed. Ch. 24: "Biosynthesis of Amino Acids and Heme" p. 575-600 (1988)). Thus, the output of any particular amino acid is limited by the amount

10 of that amino acid present in the cell.

B. Vitamin, Cofactor, and Nutraceutical Metabolism and Uses

Vitamins, cofactors, and nutraceuticals comprise another group of molecules which the higher animals have lost the ability to synthesize and so must ingest, although

15 they are readily synthesized by other organisms, such as bacteria. These molecules are either bioactive substances themselves, or are precursors of biologically active substances which may serve as electron carriers or intermediates in a variety of metabolic pathways. Aside from their nutritive value, these compounds also have significant industrial value as coloring agents, antioxidants, and catalysts or other

20 processing aids. (For an overview of the structure, activity, and industrial applications of these compounds, see, for example, Ullman's Encyclopedia of Industrial Chemistry, "Vitamins" vol. A27, p. 443-613, VCH: Weinheim, 1996.) The term "vitamin" is art-recognized, and includes nutrients which are required by an organism for normal functioning, but which that organism cannot synthesize by itself. The group of vitamins

25 may encompass cofactors and nutraceutical compounds. The language "cofactor" includes nonproteinaceous compounds required for a normal enzymatic activity to occur. Such compounds may be organic or inorganic; the cofactor molecules of the invention are preferably organic. The term "nutraceutical" includes dietary supplements having health benefits in plants and animals, particularly humans. Examples of such

30 molecules are vitamins, antioxidants, and also certain lipids (*e.g.*, polyunsaturated fatty acids).

The biosynthesis of these molecules in organisms capable of producing them, such as bacteria, has been largely characterized (Ullman's Encyclopedia of Industrial Chemistry, "Vitamins" vol. A27, p. 443-613, VCH: Weinheim, 1996; Michal, G. (1999) Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology, John Wiley & Sons; Ong, A.S., Niki, E. & Packer, L. (1995) "Nutrition, Lipids, Health, and Disease" Proceedings of the UNESCO/Confederation of Scientific and Technological Associations in Malaysia, and the Society for Free Radical Research – Asia, held Sept. 1-3, 1994 at Penang, Malaysia, AOCS Press: Champaign, IL X, 374 S).

Thiamin (vitamin B₁) is produced by the chemical coupling of pyrimidine and thiazole moieties. Riboflavin (vitamin B₂) is synthesized from guanosine-5'-triphosphate (GTP) and ribose-5'-phosphate. Riboflavin, in turn, is utilized for the synthesis of flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD). The family of compounds collectively termed 'vitamin B₆' (e.g., pyridoxine, pyridoxamine, pyridoxal-5'-phosphate, and the commercially used pyridoxin hydrochloride) are all derivatives of the common structural unit, 5-hydroxy-6-methylpyridine. Pantothenate (pantothenic acid, (R)-(+)-N-(2,4-dihydroxy-3,3-dimethyl-1-oxobutyl)- β -alanine) can be produced either by chemical synthesis or by fermentation. The final steps in pantothenate biosynthesis consist of the ATP-driven condensation of β -alanine and pantoic acid. The enzymes responsible for the biosynthesis steps for the conversion to pantoic acid, to β -alanine and for the condensation to pantothenic acid are known. The metabolically active form of pantothenate is Coenzyme A, for which the biosynthesis proceeds in 5 enzymatic steps. Pantothenate, pyridoxal-5'-phosphate, cysteine and ATP are the precursors of Coenzyme A. These enzymes not only catalyze the formation of pantothenate, but also the production of (R)-pantoic acid, (R)-pantolacton, (R)-panthenol (provitamin B₅), pantetheine (and its derivatives) and coenzyme A.

Biotin biosynthesis from the precursor molecule pimeloyl-CoA in microorganisms has been studied in detail and several of the genes involved have been identified. Many of the corresponding proteins have been found to also be involved in Fe-cluster synthesis and are members of the nifS class of proteins. Lipoic acid is derived from octanoic acid, and serves as a coenzyme in energy metabolism, where it becomes part of the pyruvate dehydrogenase complex and the α -ketoglutarate dehydrogenase complex. The folates are a group of substances which are all derivatives

of folic acid, which is turn is derived from L-glutamic acid, p-amino-benzoic acid and 6-methylpterin. The biosynthesis of folic acid and its derivatives, starting from the metabolism intermediates guanosine-5'-triphosphate (GTP), L-glutamic acid and p-amino-benzoic acid has been studied in detail in certain microorganisms.

5 Corrinoids (such as the cobalamines and particularly vitamin B₁₂) and porphyrines belong to a group of chemicals characterized by a tetrapyrrole ring system. The biosynthesis of vitamin B₁₂ is sufficiently complex that it has not yet been completely characterized, but many of the enzymes and substrates involved are now known. Nicotinic acid (nicotinate), and nicotinamide are pyridine derivatives which are
10 also termed 'niacin'. Niacin is the precursor of the important coenzymes NAD (nicotinamide adenine dinucleotide) and NADP (nicotinamide adenine dinucleotide phosphate) and their reduced forms.

The large-scale production of these compounds has largely relied on cell-free chemical syntheses, though some of these chemicals have also been produced by large-
15 scale culture of microorganisms, such as riboflavin, Vitamin B₆, pantothenate, and biotin. Only Vitamin B₁₂ is produced solely by fermentation, due to the complexity of its synthesis. *In vitro* methodologies require significant inputs of materials and time, often at great cost.

20 C. Purine, Pyrimidine, Nucleoside and Nucleotide Metabolism and Uses

Purine and pyrimidine metabolism genes and their corresponding proteins are important targets for the therapy of tumor diseases and viral infections. The language "purine" or "pyrimidine" includes the nitrogenous bases which are constituents of nucleic acids, co-enzymes, and nucleotides. The term "nucleotide" includes the basic
25 structural units of nucleic acid molecules, which are comprised of a nitrogenous base, a pentose sugar (in the case of RNA, the sugar is ribose; in the case of DNA, the sugar is D-deoxyribose), and phosphoric acid. The language "nucleoside" includes molecules which serve as precursors to nucleotides, but which are lacking the phosphoric acid moiety that nucleotides possess. By inhibiting the biosynthesis of these molecules, or
30 their mobilization to form nucleic acid molecules, it is possible to inhibit RNA and DNA synthesis; by inhibiting this activity in a fashion targeted to cancerous cells, the ability of tumor cells to divide and replicate may be inhibited. Additionally, there are

nucleotides which do not form nucleic acid molecules, but rather serve as energy stores (*i.e.*, AMP) or as coenzymes (*i.e.*, FAD and NAD).

Several publications have described the use of these chemicals for these medical indications, by influencing purine and/or pyrimidine metabolism (*e.g.* Christopherson, R.I. and Lyons, S.D. (1990) "Potent inhibitors of *de novo* pyrimidine and purine biosynthesis as chemotherapeutic agents." *Med. Res. Reviews* 10: 505-548). Studies of enzymes involved in purine and pyrimidine metabolism have been focused on the development of new drugs which can be used, for example, as immunosuppressants or anti-proliferants (Smith, J.L., (1995) "Enzymes in nucleotide synthesis." *Curr. Opin. Struct. Biol.* 5: 752-757; (1995) *Biochem Soc. Transact.* 23: 877-902). However, purine and pyrimidine bases, nucleosides and nucleotides have other utilities: as intermediates in the biosynthesis of several fine chemicals (*e.g.*, thiamine, S-adenosyl-methionine, folates, or riboflavin), as energy carriers for the cell (*e.g.*, ATP or GTP), and for chemicals themselves, commonly used as flavor enhancers (*e.g.*, IMP or GMP) or for several medicinal applications (see, for example, Kuninaka, A. (1996) *Nucleotides and Related Compounds in Biotechnology* vol. 6, Rehm *et al.*, eds. VCH: Weinheim, p. 561-612). Also, enzymes involved in purine, pyrimidine, nucleoside, or nucleotide metabolism are increasingly serving as targets against which chemicals for crop protection, including fungicides, herbicides and insecticides, are developed.

The metabolism of these compounds in bacteria has been characterized (for reviews see, for example, Zalkin, H. and Dixon, J.E. (1992) "*de novo* purine nucleotide biosynthesis", in: *Progress in Nucleic Acid Research and Molecular Biology*, vol. 42, Academic Press:, p. 259-287; and Michal, G. (1999) "Nucleotides and Nucleosides", Chapter 8 in: *Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology*, Wiley: New York). Purine metabolism has been the subject of intensive research, and is essential to the normal functioning of the cell. Impaired purine metabolism in higher animals can cause severe disease, such as gout. Purine nucleotides are synthesized from ribose-5-phosphate, in a series of steps through the intermediate compound inosine-5'-phosphate (IMP), resulting in the production of guanosine-5'-monophosphate (GMP) or adenosine-5'-monophosphate (AMP), from which the triphosphate forms utilized as nucleotides are readily formed. These compounds are also utilized as energy stores, so their degradation provides energy for many different biochemical processes in the cell.

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Pyrimidine biosynthesis proceeds by the formation of uridine-5'-monophosphate (UMP) from ribose-5-phosphate. UMP, in turn, is converted to cytidine-5'-triphosphate (CTP). The deoxy- forms of all of these nucleotides are produced in a one step reduction reaction from the diphosphate ribose form of the nucleotide to the diphosphate deoxyribose form of the nucleotide. Upon phosphorylation, these molecules are able to participate in DNA synthesis.

D. Trehalose Metabolism and Uses

Trehalose consists of two glucose molecules, bound in α, α -1,1 linkage. It is commonly used in the food industry as a sweetener, an additive for dried or frozen foods, and in beverages. However, it also has applications in the pharmaceutical, cosmetics and biotechnology industries (see, for example, Nishimoto *et al.*, (1998) U.S. Patent No. 5,759,610; Singer, M.A. and Lindquist, S. (1998) *Trends Biotech.* 16: 460-467; Paiva, C.L.A. and Panek, A.D. (1996) *Biotech. Ann. Rev.* 2: 293-314; and Shiosaka, M. (1997) *J. Japan* 172: 97-102). Trehalose is produced by enzymes from many microorganisms and is naturally released into the surrounding medium, from which it can be collected using methods known in the art.

II. Resistance to Damage from Chemicals, Environmental Stress, and Antibiotics

Production of fine chemicals is typically performed by large-scale culture of bacteria developed to produce and secrete large quantities of these molecules. However, this type of large-scale fermentation results in the subjection of the microorganisms to stresses of various kinds. These stresses include environmental stress and chemical stress.

A. Resistance to Environmental Stress

Examples of environmental stresses typically encountered in large-scale fermentative culture include mechanical stress, heat stress, stress due to limited oxygen, stress due to oxygen radicals, pH stress, and osmotic stress. The stirring mechanism used in most large-scale fermentors to ensure aeration of the culture produces heat, thus increasing the temperature of the culture. Increases in temperature induce the well-characterized heat shock response, in which a set of proteins are expressed which not

only aid in the survival of the bacterium in the face of high temperatures, but also increase survival in response to a number of other environmental stresses (see Neidhardt, F.C., *et al.*, eds. (1996) *E. coli* and *Salmonella*. ASM Press: Washington, D.C., p. 1382-1399; Wosten, M. M. (1998) *FEMS Microbiology Reviews* 22(3): 127-50; 5 Bahl, H. *et al.* (1995) *FEMS Microbiology Reviews* 17(3): 341-348; Zimmerman, J.L., Cohill, P.R. (1991) *New Biologist* 3(7): 641-650; Samali, A., and Orrenius, S. (1998) *Cell. Stress Chaperones* 3(4): 228-236, and references contained therein from each of these citations). Regulation of the heat shock response in bacteria is facilitated by specific sigma factors and other cellular regulators of gene expression (Hecker, M., 10 Volker, U (1998). *Molecular Microbiology* 29(5): 1129-1136). One of the largest problems that the cell encounters when exposed to high temperature is that protein folding is impaired; nascent proteins have sufficient kinetic energy in high temperature circumstances that it is difficult for the growing polypeptide chain to remain in a stable conformation long enough to fold properly. Thus, two of the key types of proteins 15 expressed during the heat shock response consist of chaperones (proteins which assist in the folding or unfolding of other proteins – see, *e.g.*, Fink, A.L. (1999) *Physiol. Rev.* 79(2): 425-449), and proteases, which can destroy any improperly folded proteins. Examples of chaperones expressed during the heat shock response include GroEL and DNAK; proteases known to be expressed during this cellular reaction to heat shock 20 include Lon, FtsH, and ClpB.

Other environmental stresses besides heat may also provoke a stress response. Though the fermentor stirring process is meant to introduce oxygen into the culture, oxygen may remain in limited supply, particularly when the culture is advanced in growth and the oxygen needs of the culture are thereby increased; an insufficient supply 25 of oxygen is another stress for the microorganism. Cells in fermentor cultures are also subjected to a number of osmotic stresses, particularly when nutrients are added to the culture, resulting in a high extracellular and low intracellular concentration of these molecules. Further, the large quantities of the desired molecules produced by these organisms in culture may contribute to osmotic stress of the bacteria. Lastly, aerobic 30 metabolism such as that used by *C. glutamicum* results in carbon dioxide as a waste product; secretion of this molecule may acidify the culture medium due to conversion of this molecule to carboxylic acid. Thus, bacteria in culture are also frequently subjected

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to acidic pH stress. The converse may also be true – when high levels of basic waste molecules such as ammonium are present in the culture medium, the bacteria in culture may be subjected to basic pH stress as well.

To combat such environmental stresses, bacteria have elegant gene systems which are expressed upon exposure to one or more stresses, such as the aforementioned heat shock system. Genes expressed in response to osmotic stress, for example, encode proteins capable of transporting or synthesizing compatible solutes such that osmotic intake or export of a particular molecule is slowed to manageable levels. Other examples of stress-induced bacterial proteins are those involved in trehalose biosynthesis, those encoding enzymes involved in ppGpp metabolism, those involved in signal transduction, particularly those encoding two-component systems which are sensitive to osmotic pressure, and those encoding transcription factors which are responsive to a variety of stress factors (*e.g.*, RssB analogues and/or sigma factors). Many other such genes and their protein products are known in the art.

15

B. Resistance to Chemical Stress

Aside from environmental stresses, cells may also experience a number of chemical stresses. These may fall into two categories. The first are natural waste products of metabolism and other cellular processes which are secreted by the cell to the surrounding medium. The second are chemicals present in the extracellular medium which do not originate from the cell. Generally, when cells excrete toxic waste products from the concentrated intracellular cytoplasm into the relatively much more dilute extracellular medium, these products dissipate such that extracellular levels of the possibly toxic compound are quite low. However, in large-scale fermentative culture of the bacterium, this may not be the case: so many bacteria are grown in a relatively small environment and at such a high metabolic rate that waste products may accumulate in the medium to nearly toxic levels. Examples of such wastes are carbon dioxide, metal ions, and reactive oxygen species such as hydrogen peroxide. These compounds may interfere with the activity or structure of cell surface molecules, or may re-enter the cell, where they can seriously damage proteins and nucleic acids alike. Certain other chemicals hazardous to the normal functioning of cells may be naturally found in the extracellular medium. For example, metal ions such as mercury, cadmium, nickel or

30

copper are frequently found in water sources, and may form tight complexes with cellular enzymes which prevent the normal functioning of these proteins.

C. Resistance to Antibiotics

5 Bacteriocidal proteins or antibiotics, may also be found in the extracellular milieu, either through the intervention of the researcher, or as a natural product from another organism, utilized to gain a competitive advantage. Microorganisms have several art-known mechanisms to protect themselves against antimicrobial chemicals. Degradation, modification, and export of compounds toxic to the cell are common
10 methods by which microorganisms eliminate or detoxify antibiotics. Cytoplasmic 'efflux-pumps' are known in several prokaryotes and show similarities to the so-called 'multidrug resistance' proteins from higher eukaryotes (Neyfakh, A. A. , *et al.* (1991) *Proc. Natl. Acad. Sci. USA* 88: 4781-4785). Examples of such proteins include emrAB from *E. coli* (Lomovskaya, O. and K. Lewis (1992) *Proc. Natl. Acad. Sci. USA* 89:
15 8938-8942), lmrB from *B. subtilis* (Kumano, M. *et al.* (1997) *Microbiology* 143: 2775-2782), smr from *S. aureus* (Grinius, L.G. *et al.* (1992) *Plasmid* 27: 119-129) or cmr from *C. glutamicum* (Kaidoh, K. *et al.* (1997) *Micro. Drug Resist.* 3: 345-350). *C. glutamicum* itself is non-pathogenic, in contrast to several other members of the genus *Corynebacterium* , such as *C. diphtheriae* or *C. pseudotuberculosis*. Several pathogenic
20 Corynebacteria are known to have multiple resistances against a variety of antibiotics, such as *C. jeikeium* and *C. urealyticum* (Soriano, F. *et al.* (1995) *Antimicrob. Agents Chemother.* 39: 208-214).

 Lincosamides are recognized as effective antibiotics against *Corynebacterium* species (Soriano, F. *et al.* (1995) *Antimicrob. Agents Chemother.* 39: 208-214). An
25 unexpected result of the present invention was the identification of a gene encoding a lincosamide-resistance protein (in particular, a lincomycin-resistance protein). The LMRB protein from *C. glutamicum* shows 40% homology to the product of the lmrB gene from *B. subtilis* (see Genbank accession no. AL009126), as calculated using version 1.7 of the program CLUSTALW (Thompson, J.D., Higgins, D.G., Gibson, T. J.
30 (1994) *Nucl. Acids Res.* 22: 4673-4680) using standard parameters (PAIRWISE ALIGNMENT PARAMETERS: slow/accurate alignments: Gap Open Penalty = 10.00, Gap Extension Penalty = 0.10, Protein weight matrix = BLOSUM 30, DNA weight

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matrix = IUB, Fast/Approximate alignments: Gap penalty = 3, K-tuple (word) size = 1, No. of top diagonals = 5, Window size = 5, Toggle Slow/Fast pairwise alignments = slow. Multiple alignment parameters: Gap Opening Penalty = 10.00, Gap Extension Penalty = 0.05, Delay divergent sequences = 40%, DNA transitions weight = 0.50, 5 Protein weight matrix = BLOSUM series, DNA weight matrix = IUB, Use negative matrix = OFF).

Environmental stress, chemical stress, and antibiotic or other antimicrobial stress may influence the behavior of the microorganisms during fermentor culture, and may have an impact on the production of the desired compound from these organisms.

10 For example, osmotic stress of a microorganism may cause inappropriate or inappropriately rapid uptake of one or more compounds which can ultimately lead to cellular damage or death due to osmotic shock. Similarly, chemicals present in the culture, either exogenously added (*e.g.*, antimicrobial compounds intended to eliminate unwanted microbes) or generated by the bacteria themselves (*e.g.*, waste compounds

15 such as heavy metals or oxygen radicals, or even antimicrobial compounds) may result in inhibition of fine chemical production or even death of the organism. The genes of the invention encode *C. glutamicum* proteins which act to prevent cell damage or death, by specifically counteracting the source or effect of the environmental or chemical stress.

20

III. Elements and Methods of the Invention

The present invention is based, at least in part, on the discovery of novel molecules, referred to herein as SRT nucleic acid and protein molecules, which increase the ability of *C. glutamicum* to survive in chemically or environmentally hazardous

25 settings. In one embodiment, the SRT molecules function to confer resistance to one or more environmental or chemical stresses to *C. glutamicum*. In a preferred embodiment, the activity of the SRT molecules of the present invention has an impact on the production of a desired fine chemical by this organism. In a particularly preferred embodiment, the SRT molecules of the invention are modulated in activity, such that the

30 yield, production, and/or efficiency of production of one or more fine chemicals from *C. glutamicum* is also modulated.

The language, "SRT protein" or "SRT polypeptide" includes proteins which participate in the resistance of *C. glutamicum* to one or more environmental or chemical stresses. Examples of SRT proteins include those encoded by the SRT genes set forth in Table 1 and by the odd-numbered SEQ ID NOs. The terms "SRT gene" or "SRT
5 nucleic acid sequence" include nucleic acid sequences encoding an SRT protein, which consist of a coding region and also corresponding untranslated 5' and 3' sequence regions. Examples of SRT genes include those set forth in Table 1. The terms "production" or "productivity" are art-recognized and include the concentration of the fermentation product (for example, the desired fine chemical) formed within a given
10 time and a given fermentation volume (*e.g.*, kg product per hour per liter). The term "efficiency of production" includes the time required for a particular level of production to be achieved (for example, how long it takes for the cell to attain a particular rate of output of a fine chemical). The term "yield" or "product/carbon yield" is art-recognized and includes the efficiency of the conversion of the carbon source into the product (*i.e.*,
15 fine chemical). This is generally written as, for example, kg product per kg carbon source. By increasing the yield or production of the compound, the quantity of recovered molecules, or of useful recovered molecules of that compound in a given amount of culture over a given amount of time is increased. The terms "biosynthesis" or a "biosynthetic pathway" are art-recognized and include the synthesis of a compound,
20 preferably an organic compound, by a cell from intermediate compounds in what may be a multistep and highly regulated process. The terms "degradation" or a "degradation pathway" are art-recognized and include the breakdown of a compound, preferably an organic compound, by a cell to degradation products (generally speaking, smaller or less complex molecules) in what may be a multistep and highly regulated process. The
25 language "metabolism" is art-recognized and includes the totality of the biochemical reactions that take place in an organism. The metabolism of a particular compound, then, (*e.g.*, the metabolism of an amino acid such as glycine) comprises the overall biosynthetic, modification, and degradation pathways in the cell related to this compound. The terms "resistance" and "tolerance" are art-known and include the ability
30 of a cell to not be affected by exposure to a chemical or an environment which would otherwise be detrimental to the normal functioning of these organisms. The terms "stress" or "hazard" include factors which are detrimental to the normal functioning of

cells such as *C. glutamicum*. Examples of stresses include “chemical stress”, in which a cell is exposed to one or more chemicals which are detrimental to the cell, and “environmental stress” where a cell is exposed to an environmental condition outside of those to which it is adapted. Chemical stresses may be either natural metabolic waste products such as, but not limited to reactive oxygen species or carbon dioxide, or chemicals otherwise present in the environment, including, but not limited to heavy metal ions or bacteriocidal proteins such as antibiotics. Environmental stresses may be, but are not limited to temperatures outside of the normal range, suboptimal oxygen availability, osmotic pressures, or extremes of pH, for example.

10 In another embodiment, the SRT molecules of the invention are capable of modulating the production of a desired molecule, such as a fine chemical, in a microorganism such as *C. glutamicum*. Using recombinant genetic techniques, one or more of the SRT proteins of the invention may be manipulated such that its function is modulated. The alteration of activity of stress response, resistance or tolerance genes
15 such that the cell is increased in tolerance to one or more stresses may improve the ability of that cell to grow and multiply in the relatively stressful conditions of large-scale fermentor culture. For example, by overexpressing or engineering a heat-shock induced chaperone molecule such that it is optimized in activity, one may increase the ability of the bacterium to correctly fold proteins in the face of nonoptimal temperature
20 conditions. By having fewer misfolded (and possibly misregulated or nonfunctional) proteins, the cell is increased in its ability to function normally in such a culture, which should in turn provide increased viability. This overall increase in number of cells having greater viability and activity in the culture should also result in an increase in the yield, production, and/or efficiency of production of one or more desired fine chemicals,
25 due at least to the relatively greater number of cells producing these chemicals in the culture.

The isolated nucleic acid sequences of the invention are contained within the genome of a *Corynebacterium glutamicum* strain available through the American Type Culture Collection, given designation ATCC 13032. The nucleotide sequence of the
30 isolated *C. glutamicum* SRT DNAs and the predicted amino acid sequences of the *C. glutamicum* SRT proteins are shown the Sequence Listing as odd-numbered SEQ ID NOs and even-numbered SEQ ID NOs, respectively.,.

Computational analyses were performed which classified and/or identified these nucleotide sequences as sequences which encode chemical and environmental stress, resistance, and tolerance proteins.

The present invention also pertains to proteins which have an amino acid sequence which is substantially homologous to an amino acid sequence of the invention (e.g., the sequence of an even-numbered SEQ ID NO of the Sequence Listing). As used herein, a protein which has an amino acid sequence which is substantially homologous to a selected amino acid sequence is least about 50% homologous to the selected amino acid sequence, e.g., the entire selected amino acid sequence. A protein which has an amino acid sequence which is substantially homologous to a selected amino acid sequence can also be least about 50-60%, preferably at least about 60-70%, and more preferably at least about 70-80%, 80-90%, or 90-95%, and most preferably at least about 96%, 97%, 98%, 99% or more homologous to the selected amino acid sequence. Ranges and identity values intermediate to the above-recited values, (e.g., 75%-80% identical, 85-87% identical, 91-92% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower limits are intended to be included.

The SRT proteins or biologically active portions or fragments thereof of the invention can confer resistance or tolerance to one or more chemical or environmental stresses, or may have one or more of the activities set forth in Table 1.

Various aspects of the invention are described in further detail in the following subsections:

A. Isolated Nucleic Acid Molecules

One aspect of the invention pertains to isolated nucleic acid molecules that encode SRT polypeptides or biologically active portions thereof, as well as nucleic acid fragments sufficient for use as hybridization probes or primers for the identification or amplification of SRT-encoding nucleic acid (e.g., SRT DNA). As used herein, the term "nucleic acid molecule" is intended to include DNA molecules (e.g., cDNA or genomic DNA) and RNA molecules (e.g., mRNA) and analogs of the DNA or RNA generated using nucleotide analogs. This term also encompasses untranslated sequence located at both the 3' and 5' ends of the coding region of the gene: at least about 100 nucleotides

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of sequence upstream from the 5' end of the coding region and at least about 20 nucleotides of sequence downstream from the 3' end of the coding region of the gene. The nucleic acid molecule can be single-stranded or double-stranded, but preferably is double-stranded DNA. An "isolated" nucleic acid molecule is one which is separated
5 from other nucleic acid molecules which are present in the natural source of the nucleic acid. Preferably, an "isolated" nucleic acid is free of sequences which naturally flank the nucleic acid (*i.e.*, sequences located at the 5' and 3' ends of the nucleic acid) in the genomic DNA of the organism from which the nucleic acid is derived. For example, in various embodiments, the isolated SRT nucleic acid molecule can contain less than
10 about 5 kb, 4kb, 3kb, 2kb, 1 kb, 0.5 kb or 0.1 kb of nucleotide sequences which naturally flank the nucleic acid molecule in genomic DNA of the cell from which the nucleic acid is derived (*e.g.*, a *C. glutamicum* cell). Moreover, an "isolated" nucleic acid molecule, such as a DNA molecule, can be substantially free of other cellular material, or culture medium when produced by recombinant techniques, or chemical precursors or
15 other chemicals when chemically synthesized.

A nucleic acid molecule of the present invention, *e.g.*, a nucleic acid molecule having a nucleotide sequence of an odd-numbered SEQ ID NO of the Sequence Listing, or a portion thereof, can be isolated using standard molecular biology techniques and the sequence information provided herein. For example, a *C. glutamicum* SRT DNA can be
20 isolated from a *C. glutamicum* library using all or portion of one of the odd-numbered SEQ ID NO sequences of the Sequence Listing as a hybridization probe and standard hybridization techniques (*e.g.*, as described in Sambrook, J., Fritsh, E. F., and Maniatis, T. *Molecular Cloning: A Laboratory Manual*. 2nd, ed., Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989).
25 Moreover, a nucleic acid molecule encompassing all or a portion of one of the nucleic acid sequences of the invention (*e.g.*, an odd-numbered SEQ ID NO:) can be isolated by the polymerase chain reaction using oligonucleotide primers designed based upon this sequence (*e.g.*, a nucleic acid molecule encompassing all or a portion of one of the nucleic acid sequences of the invention (*e.g.*, an odd-numbered SEQ ID NO of the
30 Sequence Listing) can be isolated by the polymerase chain reaction using oligonucleotide primers designed based upon this same sequence). For example, mRNA can be isolated from normal endothelial cells (*e.g.*, by the guanidinium-thiocyanate

extraction procedure of Chirgwin *et al.* (1979) *Biochemistry* 18: 5294-5299) and DNA can be prepared using reverse transcriptase (*e.g.*, Moloney MLV reverse transcriptase, available from Gibco/BRL, Bethesda, MD; or AMV reverse transcriptase, available from Seikagaku America, Inc., St. Petersburg, FL). Synthetic oligonucleotide primers
5 for polymerase chain reaction amplification can be designed based upon one of the nucleotide sequences shown in the Sequence Listing. A nucleic acid of the invention can be amplified using cDNA or, alternatively, genomic DNA, as a template and appropriate oligonucleotide primers according to standard PCR amplification techniques. The nucleic acid so amplified can be cloned into an appropriate vector and
10 characterized by DNA sequence analysis. Furthermore, oligonucleotides corresponding to an SRT nucleotide sequence can be prepared by standard synthetic techniques, *e.g.*, using an automated DNA synthesizer.

In a preferred embodiment, an isolated nucleic acid molecule of the invention comprises one of the nucleotide sequences shown in the Sequence Listing. The nucleic
15 acid sequences of the invention, as set forth in the Sequence Listing, correspond to the *Corynebacterium glutamicum* SRT DNAs of the invention. This DNA comprises sequences encoding SRT proteins (*i.e.*, the "coding region", indicated in each odd-numbered SEQ ID NO: sequence in the Sequence Listing), as well as 5' untranslated sequences and 3' untranslated sequences, also indicated in each odd-numbered SEQ ID
20 NO: in the Sequence Listing. Alternatively, the nucleic acid molecule can comprise only the coding region of any of the nucleic acid sequences of the Sequence Listing.

For the purposes of this application, it will be understood that each of the nucleic acid and amino acid sequences set forth in the Sequence Listing has an identifying RXA, RXN, or RXS number having the designation "RXA", "RXN", or "RXS" followed by 5
25 digits (*i.e.*, RXA01524, RXN00493, or RXS01027). Each of the nucleic acid sequences comprises up to three parts: a 5' upstream region, a coding region, and a downstream region. Each of these three regions is identified by the same RXA, RXN, or RXS designation to eliminate confusion. The recitation "one of the odd-numbered sequences of the Sequence Listing", then, refers to any of the nucleic acid sequences in the
30 Sequence Listing, which may be also be distinguished by their differing RXA, RXN, or RXS designations. The coding region of each of these sequences is translated into a corresponding amino acid sequence, which is also set forth in the Sequence Listing, as an

even-numbered SEQ ID NO: immediately following the corresponding nucleic acid sequence. For example, the coding region for RXA01524 is set forth in SEQ ID NO:1, while the amino acid sequence which it encodes is set forth as SEQ ID NO:2. The sequences of the nucleic acid molecules of the invention are identified by the same
5 RXA, RXN, or RXS designations as the amino acid molecules which they encode, such that they can be readily correlated. For example, the amino acid sequence designated RXA01524 is a translation of the coding region of the nucleotide sequence of nucleic acid molecule RXA01524, the amino acid sequence designated RXN00034 is a translation of the coding region of the nucleotide sequence of nucleic acid molecule
10 RXN00034, and the amino acid sequence in designated RXS00568 is a translation of the coding region of the nucleotide sequence of nucleic acid molecule RXS00568. The correspondence between the RXA, RXN, and RXS nucleotide and amino acid sequences of the invention and their assigned SEQ ID NOs is set forth in Table 1.

Several of the genes of the invention are "F-designated genes". An F-designated
15 gene includes those genes set forth in Table 1 which have an 'F' in front of the RXA, RXN, or RXS designation. For example, SEQ ID NO:7, designated, as indicated on Table 1, as "F RXA00498", is an F-designated gene, as are SEQ ID NOs: 25, 33, and 37 (designated on Table 1 as "F RXA01345", "F RXA02543", and "F RXA02282", respectively).

20 In one embodiment, the nucleic acid molecules of the present invention are not intended to include those compiled in Table 2. In the case of the *dapD* gene, a sequence for this gene was published in Wehrmann, A., *et al.* (1998) *J. Bacteriol.* 180(12): 3159-3165. However, the sequence obtained by the inventors of the present application is significantly longer than the published version. It is believed that the published version
25 relied on an incorrect start codon, and thus represents only a fragment of the actual coding region.

In another preferred embodiment, an isolated nucleic acid molecule of the invention comprises a nucleic acid molecule which is a complement of one of the nucleotide sequences of the invention (*e.g.*, a sequence of an odd-numbered SEQ ID
30 NO: of the Sequence Listing, or a portion thereof. A nucleic acid molecule which is complementary to one of the nucleotide sequences of the invention is one which is sufficiently complementary to one of the nucleotide sequences shown in the Sequence

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Listing (*e.g.*, the sequence of an odd-numbered SEQ ID NO:) such that it can hybridize to one of the nucleotide sequences of the invention, thereby forming a stable duplex.

In still another preferred embodiment, an isolated nucleic acid molecule of the invention comprises a nucleotide sequence which is at least about 50%, 51%, 52%, 53%,
5 54%, 55%, 56%, 57%, 58%, 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more homologous to a nucleotide sequence of the
10 invention (*e.g.*, a sequence of an odd-numbered SEQ ID NO: of the Sequence Listing), or a portion thereof. Ranges and identity values intermediate to the above-recited ranges, (*e.g.*, 70-90% identical or 80-95% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower limits are intended to be included. In an
15 additional preferred embodiment, an isolated nucleic acid molecule of the invention comprises a nucleotide sequence which hybridizes, *e.g.*, hybridizes under stringent conditions, to one of the nucleotide sequences of the invention,, or a portion thereof.

Moreover, the nucleic acid molecule of the invention can comprise only a portion of the coding region of the sequence of one of the odd-numbered SEQ ID NOs
20 of the Sequence Listing for example a fragment which can be used as a probe or primer or a fragment encoding a biologically active portion of an SRT protein. The nucleotide sequences determined from the cloning of the SRT genes from *C. glutamicum* allows for the generation of probes and primers designed for use in identifying and/or cloning SRT homologues in other cell types and organisms, as well as SRT homologues from other
25 *Corynebacteria* or related species. The probe/primer typically comprises substantially purified oligonucleotide. The oligonucleotide typically comprises a region of nucleotide sequence that hybridizes under stringent conditions to at least about 12, preferably about 25, more preferably about 40, 50 or 75 consecutive nucleotides of a sense strand of one of the nucleotide sequences of the invention (*e.g.*, a sequence of one of the odd-
30 numbered SEQ ID NOs of the Sequence Listing),, an anti-sense sequence of one of these sequences, or naturally occurring mutants thereof. Primers based on a nucleotide sequence of the invention can be used in PCR reactions to clone SRT homologues.

Probes based on the SRT nucleotide sequences can be used to detect transcripts or genomic sequences encoding the same or homologous proteins. In preferred embodiments, the probe further comprises a label group attached thereto, *e.g.* the label group can be a radioisotope, a fluorescent compound, an enzyme, or an enzyme co-
5 factor. Such probes can be used as a part of a diagnostic test kit for identifying cells which misexpress an SRT protein, such as by measuring a level of an SRT-encoding nucleic acid in a sample of cells, *e.g.*, detecting SRT mRNA levels or determining whether a genomic SRT gene has been mutated or deleted.

In one embodiment, the nucleic acid molecule of the invention encodes a protein
10 or portion thereof which includes an amino acid sequence which is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO of the Sequence Listing) such that the protein or portion thereof maintains the ability to confer resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses. As used herein, the language "sufficiently
15 homologous" refers to proteins or portions thereof which have amino acid sequences which include a minimum number of identical or equivalent (*e.g.*, an amino acid residue which has a similar side chain as an amino acid residue in a sequence of one of the even-numbered SEQ ID NOs of the Sequence Listing) amino acid residues to an amino acid sequence of the invention such that the protein or portion thereof is capable of
20 participating in the resistance of *C. glutamicum* to one or more chemical or environmental stresses. Protein members of such metabolic pathways, as described herein, function to increase the resistance or tolerance of *C. glutamicum* to one or more environmental or chemical hazards or stresses. Examples of such activities are also described herein. Thus, "the function of an SRT protein" contributes to the overall
25 resistance of *C. glutamicum* to elements of its surroundings which may impede its normal growth or functioning, and/or contributes, either directly or indirectly, to the yield, production, and/or efficiency of production of one or more fine chemicals. Examples of SRT protein activities are set forth in Table 1.

In another embodiment, the protein is at least about 50-60%, preferably at least
30 about 60-70%, and more preferably at least about 70-80%, 80-90%, 90-95%, and most preferably at least about 96%, 97%, 98%, 99% or more homologous to an entire amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of

the Sequence Listing). Ranges and identity values intermediate to the above-recited values, (*e.g.*, 75%-80% identical, 85-87% identical, or 91-92% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower
5 limits are intended to be included.

Portions of proteins encoded by the SRT nucleic acid molecules of the invention are preferably biologically active portions of one of the SRT proteins. As used herein, the term "biologically active portion of an SRT protein" is intended to include a portion, *e.g.*, a domain/motif, of an SRT protein that is capable of imparting resistance or
10 tolerance to one or more environmental or chemical stresses or hazards, or has an activity as set forth in Table 1. To determine whether an SRT protein or a biologically active portion thereof can increase the resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses or hazards, an assay of enzymatic activity may be performed. Such assay methods are well known to those of ordinary skill in the art, as
15 detailed in Example 8 of the Exemplification.

Additional nucleic acid fragments encoding biologically active portions of an SRT protein can be prepared by isolating a portion of one of the amino acid sequences of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of the Sequence Listing), expressing the encoded portion of the SRT protein or peptide (*e.g.*, by
20 recombinant expression *in vitro*) and assessing the activity of the encoded portion of the SRT protein or peptide.

The invention further encompasses nucleic acid molecules that differ from one of the nucleotide sequences of the invention (*e.g.*, a sequence of an odd-numbered SEQ ID NO: of the Sequence Listing) (and portions thereof) due to degeneracy of the genetic
25 code and thus encode the same SRT protein as that encoded by the nucleotide sequences of the invention. In another embodiment, an isolated nucleic acid molecule of the invention has a nucleotide sequence encoding a protein having an amino acid sequence shown in the Sequence Listing (*e.g.*, an even-numbered SEQ ID NO:). In a still further embodiment, the nucleic acid molecule of the invention encodes a full length *C.*
30 *glutamicum* protein which is substantially homologous to an amino acid sequence of the invention (encoded by an open reading frame shown in an odd-numbered SEQ ID NO: of the Sequence Listing).

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It will be understood by one of ordinary skill in the art that in one embodiment the sequences of the invention are not meant to include the sequences of the prior art, such as those Genbank sequences set forth in Tables 2 or 4 which were available prior to the present invention. In one embodiment, the invention includes nucleotide and amino acid sequences having a percent identity to a nucleotide or amino acid sequence of the invention which is greater than that of a sequence of the prior art (*e.g.*, a Genbank sequence (or the protein encoded by such a sequence) set forth in Tables 2 or 4). For example, the invention includes a nucleotide sequence which is greater than and/or at least 39% identical to the nucleotide sequence designated RXA00084 (SEQ ID NO:189), a nucleotide sequence which is greater than and/or at least 56% identical to the nucleotide sequence designated RXA00605 (SEQ ID NO:11), and a nucleotide sequence which is greater than and/or at least 50% identical to the nucleotide sequence designated RXA00886 (SEQ ID NO:39). One of ordinary skill in the art would be able to calculate the lower threshold of percent identity for any given sequence of the invention by examining the GAP-calculated percent identity scores set forth in Table 4 for each of the three top hits for the given sequence, and by subtracting the highest GAP-calculated percent identity from 100 percent. One of ordinary skill in the art will also appreciate that nucleic acid and amino acid sequences having percent identities greater than the lower threshold so calculated (*e.g.*, at least 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more identical) are also encompassed by the invention.

In addition to the *C. glutamicum* SRT nucleotide sequences set forth in the Sequence Listing as odd-numbered SEQ ID NOs, it will be appreciated by one of ordinary skill in the art that DNA sequence polymorphisms that lead to changes in the amino acid sequences of SRT proteins may exist within a population (*e.g.*, the *C. glutamicum* population). Such genetic polymorphism in the SRT gene may exist among individuals within a population due to natural variation. As used herein, the terms "gene" and "recombinant gene" refer to nucleic acid molecules comprising an open reading frame encoding an SRT protein, preferably a *C. glutamicum* SRT protein. Such

natural variations can typically result in 1-5% variance in the nucleotide sequence of the SRT gene. Any and all such nucleotide variations and resulting amino acid polymorphisms in SRT that are the result of natural variation and that do not alter the functional activity of SRT proteins are intended to be within the scope of the invention.

5 Nucleic acid molecules corresponding to natural variants and non-*C. glutamicum* homologues of the *C. glutamicum* SRT DNA of the invention can be isolated based on their homology to the *C. glutamicum* SRT nucleic acid disclosed herein using the *C. glutamicum* DNA, or a portion thereof, as a hybridization probe according to standard hybridization techniques under stringent hybridization conditions. Accordingly, in
10 another embodiment, an isolated nucleic acid molecule of the invention is at least 15 nucleotides in length and hybridizes under stringent conditions to the nucleic acid molecule comprising a nucleotide sequence of an odd-numbered SEQ ID NO: of the Sequence Listing. In other embodiments, the nucleic acid is at least 30, 50, 100, 250 or more nucleotides in length. As used herein, the term "hybridizes under stringent
15 conditions" is intended to describe conditions for hybridization and washing under which nucleotide sequences at least 60% homologous to each other typically remain hybridized to each other. Preferably, the conditions are such that sequences at least about 65%, more preferably at least about 70%, and even more preferably at least about 75% or more homologous to each other typically remain hybridized to each other. Such
20 stringent conditions are known to those of ordinary skill in the art in the art and can be found in Ausubel *et al.*, *Current Protocols in Molecular Biology*, John Wiley & Sons, N.Y. (1989), 6.3.1-6.3.6. A preferred, non-limiting example of stringent hybridization conditions are hybridization in 6X sodium chloride/sodium citrate (SSC) at about 45°C, followed by one or more washes in 0.2 X SSC, 0.1% SDS at 50-65°C. Preferably, an
25 isolated nucleic acid molecule of the invention that hybridizes under stringent conditions to a nucleotide sequence of the invention corresponds to a naturally-occurring nucleic acid molecule. As used herein, a "naturally-occurring" nucleic acid molecule refers to an RNA or DNA molecule having a nucleotide sequence that occurs in nature (*e.g.*, encodes a natural protein). In one embodiment, the nucleic acid encodes a natural *C.*
30 *glutamicum* SRT protein.

In addition to naturally-occurring variants of the SRT sequence that may exist in the population, one of ordinary skill in the art will further appreciate that changes can be

introduced by mutation into a nucleotide sequence of the invention, thereby leading to changes in the amino acid sequence of the encoded SRT protein, without altering the functional ability of the SRT protein. For example, nucleotide substitutions leading to amino acid substitutions at "non-essential" amino acid residues can be made in a
5 nucleotide sequence of the invention. A "non-essential" amino acid residue is a residue that can be altered from the wild-type sequence of one of the SRT proteins (*e.g.*, an even-numbered SEQ ID NO: of the Sequence Listing) without altering the activity of said SRT protein, whereas an "essential" amino acid residue is required for SRT protein activity. Other amino acid residues, however, (*e.g.*, those that are not conserved or only
10 semi-conserved in the domain having SRT activity) may not be essential for activity and thus are likely to be amenable to alteration without altering SRT activity.

Accordingly, another aspect of the invention pertains to nucleic acid molecules encoding SRT proteins that contain changes in amino acid residues that are not essential for SRT activity. Such SRT proteins differ in amino acid sequence from a sequence of
15 an even-numbered SEQ ID NO: of the Sequence Listing yet retain at least one of the SRT activities described herein. In one embodiment, the isolated nucleic acid molecule comprises a nucleotide sequence encoding a protein, wherein the protein comprises an amino acid sequence at least about 50% homologous to an amino acid sequence of the invention and is capable of increasing the resistance or tolerance of *C. glutamicum* to
20 one or more environmental or chemical stresses, or has one or more of the activities set forth in Table 1. Preferably, the protein encoded by the nucleic acid molecule is at least about 50-60% homologous to the amino acid sequence of one of the odd-numbered SEQ ID NOs of the Sequence Listing, more preferably at least about 60-70% homologous to one of these sequences, even more preferably at least about 70-80%, 80-90%, 90-95%
25 homologous to one of these sequences in, and most preferably at least about 96%, 97%, 98%, or 99% homologous to one of the amino acid sequences of the invention.

To determine the percent homology of two amino acid sequences (*e.g.*, one of the amino acid sequences of the invention and a mutant form thereof) or of two nucleic acids, the sequences are aligned for optimal comparison purposes (*e.g.*, gaps can be
30 introduced in the sequence of one protein or nucleic acid for optimal alignment with the other protein or nucleic acid). The amino acid residues or nucleotides at corresponding amino acid positions or nucleotide positions are then compared. When a position in one

sequence (*e.g.*, one of the amino acid sequences of the invention) is occupied by the same amino acid residue or nucleotide as the corresponding position in the other sequence (*e.g.*, a mutant form of the amino acid sequence), then the molecules are homologous at that position (*i.e.*, as used herein amino acid or nucleic acid "homology" is equivalent to amino acid or nucleic acid "identity"). The percent homology between the two sequences is a function of the number of identical positions shared by the sequences (*i.e.*, % homology = # of identical positions/total # of positions x 100).

An isolated nucleic acid molecule encoding an SRT protein homologous to a protein sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) can be created by introducing one or more nucleotide substitutions, additions or deletions into a nucleotide sequence of the invention such that one or more amino acid substitutions, additions or deletions are introduced into the encoded protein. Mutations can be introduced into one of the nucleotide sequences of the invention by standard techniques, such as site-directed mutagenesis and PCR-mediated mutagenesis. Preferably, conservative amino acid substitutions are made at one or more predicted non-essential amino acid residues. A "conservative amino acid substitution" is one in which the amino acid residue is replaced with an amino acid residue having a similar side chain. Families of amino acid residues having similar side chains have been defined in the art. These families include amino acids with basic side chains (*e.g.*, lysine, arginine, histidine), acidic side chains (*e.g.*, aspartic acid, glutamic acid), uncharged polar side chains (*e.g.*, glycine, asparagine, glutamine, serine, threonine, tyrosine, cysteine), nonpolar side chains (*e.g.*, alanine, valine, leucine, isoleucine, proline, phenylalanine, methionine, tryptophan), beta-branched side chains (*e.g.*, threonine, valine, isoleucine) and aromatic side chains (*e.g.*, tyrosine, phenylalanine, tryptophan, histidine). Thus, a predicted nonessential amino acid residue in an SRT protein is preferably replaced with another amino acid residue from the same side chain family. Alternatively, in another embodiment, mutations can be introduced randomly along all or part of an SRT coding sequence, such as by saturation mutagenesis, and the resultant mutants can be screened for an SRT activity described herein to identify mutants that retain SRT activity. Following mutagenesis of one the nucleotide sequence of one of the odd-numbered SEQ ID NOs of the Sequence Listing, the encoded protein can be expressed recombinantly and the activity of the protein can

be determined using, for example, assays described herein (see Example 8 of the Exemplification).

In addition to the nucleic acid molecules encoding SRT proteins described above, another aspect of the invention pertains to isolated nucleic acid molecules which are antisense thereto. An "antisense" nucleic acid comprises a nucleotide sequence which is complementary to a "sense" nucleic acid encoding a protein, *e.g.*, complementary to the coding strand of a double-stranded DNA molecule or complementary to an mRNA sequence. Accordingly, an antisense nucleic acid can hydrogen bond to a sense nucleic acid. The antisense nucleic acid can be complementary to an entire SRT coding strand, or to only a portion thereof. In one embodiment, an antisense nucleic acid molecule is antisense to a "coding region" of the coding strand of a nucleotide sequence encoding an SRT protein. The term "coding region" refers to the region of the nucleotide sequence comprising codons which are translated into amino acid residues (*e.g.*, the entire coding region of SEQ ID NO.: 120 (RXA00600) comprises nucleotides 1 to 1098). In another embodiment, the antisense nucleic acid molecule is antisense to a "noncoding region" of the coding strand of a nucleotide sequence encoding SRT. The term "noncoding region" refers to 5' and 3' sequences which flank the coding region that are not translated into amino acids (*i.e.*, also referred to as 5' and 3' untranslated regions).

Given the coding strand sequences encoding SRT disclosed herein (*e.g.*, the sequences set forth as odd-numbered SEQ ID NOs in the Sequence Listing), antisense nucleic acids of the invention can be designed according to the rules of Watson and Crick base pairing. The antisense nucleic acid molecule can be complementary to the entire coding region of SRT mRNA, but more preferably is an oligonucleotide which is antisense to only a portion of the coding or noncoding region of SRT mRNA. For example, the antisense oligonucleotide can be complementary to the region surrounding the translation start site of SRT mRNA. An antisense oligonucleotide can be, for example, about 5, 10, 15, 20, 25, 30, 35, 40, 45 or 50 nucleotides in length. An antisense nucleic acid of the invention can be constructed using chemical synthesis and enzymatic ligation reactions using procedures known in the art. For example, an antisense nucleic acid (*e.g.*, an antisense oligonucleotide) can be chemically synthesized using naturally occurring nucleotides or variously modified nucleotides designed to

increase the biological stability of the molecules or to increase the physical stability of the duplex formed between the antisense and sense nucleic acids, *e.g.*, phosphorothioate derivatives and acridine substituted nucleotides can be used. Examples of modified nucleotides which can be used to generate the antisense nucleic acid include 5-
5 fluorouracil, 5-bromouracil, 5-chlorouracil, 5-iodouracil, hypoxanthine, xanthine, 4-acetylcytosine, 5-(carboxyhydroxymethyl) uracil, 5-carboxymethylaminomethyl-2-thiouridine, 5-carboxymethylaminomethyluracil, dihydrouracil, beta-D-galactosylqueosine, inosine, N6-isopentenyladenine, 1-methylguanine, 1-methylinosine, 2,2-dimethylguanine, 2-methyladenine, 2-methylguanine, 3-methylcytosine, 5-
10 methylcytosine, N6-adenine, 7-methylguanine, 5-methylaminomethyluracil, 5-methoxyaminomethyl-2-thiouracil, beta-D-mannosylqueosine, 5'-methoxycarboxymethyluracil, 5-methoxyuracil, 2-methylthio-N6-isopentenyladenine, uracil-5-oxyacetic acid (v), wybutoxosine, pseudouracil, queosine, 2-thiocytosine, 5-methyl-2-thiouracil, 2-thiouracil, 4-thiouracil, 5-methyluracil, uracil-5-oxyacetic acid
15 methylester, uracil-5-oxyacetic acid (v), 5-methyl-2-thiouracil, 3-(3-amino-3-N-2-carboxypropyl) uracil, (acp3)w, and 2,6-diaminopurine. Alternatively, the antisense nucleic acid can be produced biologically using an expression vector into which a nucleic acid has been subcloned in an antisense orientation (*i.e.*, RNA transcribed from the inserted nucleic acid will be of an antisense orientation to a target nucleic acid of
20 interest, described further in the following subsection).

The antisense nucleic acid molecules of the invention are typically administered to a cell or generated *in situ* such that they hybridize with or bind to cellular mRNA and/or genomic DNA encoding an SRT protein to thereby inhibit expression of the protein, *e.g.*, by inhibiting transcription and/or translation. The hybridization can be by
25 conventional nucleotide complementarity to form a stable duplex, or, for example, in the case of an antisense nucleic acid molecule which binds to DNA duplexes, through specific interactions in the major groove of the double helix. The antisense molecule can be modified such that it specifically binds to a receptor or an antigen expressed on a selected cell surface, *e.g.*, by linking the antisense nucleic acid molecule to a peptide or
30 an antibody which binds to a cell surface receptor or antigen. The antisense nucleic acid molecule can also be delivered to cells using the vectors described herein. To achieve sufficient intracellular concentrations of the antisense molecules, vector constructs in

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which the antisense nucleic acid molecule is placed under the control of a strong prokaryotic, viral, or eukaryotic promoter are preferred.

In yet another embodiment, the antisense nucleic acid molecule of the invention is an α -anomeric nucleic acid molecule. An α -anomeric nucleic acid molecule forms
5 specific double-stranded hybrids with complementary RNA in which, contrary to the usual β -units, the strands run parallel to each other (Gaultier *et al.* (1987) *Nucleic Acids Res.* 15:6625-6641). The antisense nucleic acid molecule can also comprise a 2'-O-methylribonucleotide (Inoue *et al.* (1987) *Nucleic Acids Res.* 15:6131-6148) or a chimeric RNA-DNA analogue (Inoue *et al.* (1987) *FEBS Lett.* 215:327-330).

10 In still another embodiment, an antisense nucleic acid of the invention is a ribozyme. Ribozymes are catalytic RNA molecules with ribonuclease activity which are capable of cleaving a single-stranded nucleic acid, such as an mRNA, to which they have a complementary region. Thus, ribozymes (*e.g.*, hammerhead ribozymes (described in Haselhoff and Gerlach (1988) *Nature* 334:585-591)) can be used to
15 catalytically cleave SRT mRNA transcripts to thereby inhibit translation of SRT mRNA. A ribozyme having specificity for an SRT-encoding nucleic acid can be designed based upon the nucleotide sequence of an SRT cDNA disclosed herein (*i.e.*, SEQ ID NO:119 (RXA00600)). For example, a derivative of a *Tetrahymena* L-19 IVS RNA can be constructed in which the nucleotide sequence of the active site is complementary to the
20 nucleotide sequence to be cleaved in an SRT-encoding mRNA. See, *e.g.*, Cech *et al.* U.S. Patent No. 4,987,071 and Cech *et al.* U.S. Patent No. 5,116,742. Alternatively, SRT mRNA can be used to select a catalytic RNA having a specific ribonuclease activity from a pool of RNA molecules. See, *e.g.*, Bartel, D. and Szostak, J.W. (1993) *Science* 261:1411-1418.

25 Alternatively, SRT gene expression can be inhibited by targeting nucleotide sequences complementary to the regulatory region of an SRT nucleotide sequence (*e.g.*, an SRT promoter and/or enhancers) to form triple helical structures that prevent transcription of an SRT gene in target cells. See generally, Helene, C. (1991) *Anticancer Drug Des.* 6(6):569-84; Helene, C. *et al.* (1992) *Ann. N.Y. Acad. Sci.* 660:27-
30 36; and Maher, L.J. (1992) *Bioassays* 14(12):807-15.

B. Recombinant Expression Vectors and Host Cells

Another aspect of the invention pertains to vectors, preferably expression vectors, containing a nucleic acid encoding an SRT protein (or a portion thereof). As used herein, the term "vector" refers to a nucleic acid molecule capable of transporting
5 another nucleic acid to which it has been linked. One type of vector is a "plasmid", which refers to a circular double stranded DNA loop into which additional DNA segments can be ligated. Another type of vector is a viral vector, wherein additional DNA segments can be ligated into the viral genome. Certain vectors are capable of autonomous replication in a host cell into which they are introduced (*e.g.*, bacterial
10 vectors having a bacterial origin of replication and episomal mammalian vectors). Other vectors (*e.g.*, non-episomal mammalian vectors) are integrated into the genome of a host cell upon introduction into the host cell, and thereby are replicated along with the host genome. Moreover, certain vectors are capable of directing the expression of genes to which they are operatively linked. Such vectors are referred to herein as "expression
15 vectors". In general, expression vectors of utility in recombinant DNA techniques are often in the form of plasmids. In the present specification, "plasmid" and "vector" can be used interchangeably as the plasmid is the most commonly used form of vector. However, the invention is intended to include such other forms of expression vectors, such as viral vectors (*e.g.*, replication defective retroviruses, adenoviruses and adeno-
20 associated viruses), which serve equivalent functions.

The recombinant expression vectors of the invention comprise a nucleic acid of the invention in a form suitable for expression of the nucleic acid in a host cell, which means that the recombinant expression vectors include one or more regulatory sequences, selected on the basis of the host cells to be used for expression, which is
25 operatively linked to the nucleic acid sequence to be expressed. Within a recombinant expression vector, "operably linked" is intended to mean that the nucleotide sequence of interest is linked to the regulatory sequence(s) in a manner which allows for expression of the nucleotide sequence (*e.g.*, in an *in vitro* transcription/translation system or in a host cell when the vector is introduced into the host cell). The term "regulatory
30 sequence" is intended to include promoters, enhancers and other expression control elements (*e.g.*, polyadenylation signals). Such regulatory sequences are described, for example, in Goeddel; *Gene Expression Technology: Methods in Enzymology* 185,

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Academic Press, San Diego, CA (1990). Regulatory sequences include those which direct constitutive expression of a nucleotide sequence in many types of host cell and those which direct expression of the nucleotide sequence only in certain host cells. Preferred regulatory sequences are, for example, promoters such as cos-, tac-, trp-, tet-,
5 trp-tet-, lpp-, lac-, lpp-lac-, lacI^q-, T7-, T5-, T3-, gal-, trc-, ara-, SP6-, amy, SPO2, λ -P_R- or λ P_L, which are used preferably in bacteria. Additional regulatory sequences are, for example, promoters from yeasts and fungi, such as ADC1, MF α , AC, P-60, CYC1, GAPDH, TEF, rp28, ADH, promoters from plants such as CaMV/35S, SSU, OCS, lib4, usp, STLS1, B33, nos or ubiquitin- or phaseolin-promoters. It is also possible to use
10 artificial promoters. It will be appreciated by one of ordinary skill in the art that the design of the expression vector can depend on such factors as the choice of the host cell to be transformed, the level of expression of protein desired, etc. The expression vectors of the invention can be introduced into host cells to thereby produce proteins or peptides, including fusion proteins or peptides, encoded by nucleic acids as described
15 herein (e.g., SRT proteins, mutant forms of SRT proteins, fusion proteins, etc.).

The recombinant expression vectors of the invention can be designed for expression of SRT proteins in prokaryotic or eukaryotic cells. For example, SRT genes can be expressed in bacterial cells such as *C. glutamicum*, insect cells (using baculovirus expression vectors), yeast and other fungal cells (see Romanos, M.A. *et al.* (1992)
20 "Foreign gene expression in yeast: a review", *Yeast* 8: 423-488; van den Hondel, C.A.M.J.J. *et al.* (1991) "Heterologous gene expression in filamentous fungi" in: More Gene Manipulations in Fungi, J.W. Bennet & L.L. Lasure, eds., p. 396-428: Academic Press: San Diego; and van den Hondel, C.A.M.J.J. & Punt, P.J. (1991) "Gene transfer systems and vector development for filamentous fungi, in: Applied Molecular Genetics
25 of Fungi, Peberdy, J.F. *et al.*, eds., p. 1-28, Cambridge University Press: Cambridge), algae and multicellular plant cells (see Schmidt, R. and Willmitzer, L. (1988) High efficiency *Agrobacterium tumefaciens* -mediated transformation of *Arabidopsis thaliana* leaf and cotyledon explants" *Plant Cell Rep.*: 583-586), or mammalian cells. Suitable host cells are discussed further in Goeddel, *Gene Expression Technology*:
30 *Methods in Enzymology* 185, Academic Press, San Diego, CA (1990). Alternatively, the recombinant expression vector can be transcribed and translated *in vitro*, for example using T7 promoter regulatory sequences and T7 polymerase.

Expression of proteins in prokaryotes is most often carried out with vectors containing constitutive or inducible promoters directing the expression of either fusion or non-fusion proteins. Fusion vectors add a number of amino acids to a protein encoded therein, usually to the amino terminus of the recombinant protein. Such fusion
5 vectors typically serve three purposes: 1) to increase expression of recombinant protein; 2) to increase the solubility of the recombinant protein; and 3) to aid in the purification of the recombinant protein by acting as a ligand in affinity purification. Often, in fusion expression vectors, a proteolytic cleavage site is introduced at the junction of the fusion moiety and the recombinant protein to enable separation of the recombinant protein
10 from the fusion moiety subsequent to purification of the fusion protein. Such enzymes, and their cognate recognition sequences, include Factor Xa, thrombin and enterokinase.

Typical fusion expression vectors include pGEX (Pharmacia Biotech Inc; Smith, D.B. and Johnson, K.S. (1988) *Gene* 67:31-40), pMAL (New England Biolabs, Beverly, MA) and pRIT5 (Pharmacia, Piscataway, NJ) which fuse glutathione S-transferase
15 (GST), maltose E binding protein, or protein A, respectively, to the target recombinant protein. In one embodiment, the coding sequence of the SRT protein is cloned into a pGEX expression vector to create a vector encoding a fusion protein comprising, from the N-terminus to the C-terminus, GST-thrombin cleavage site-X protein. The fusion protein can be purified by affinity chromatography using glutathione-agarose resin.
20 Recombinant SRT protein unfused to GST can be recovered by cleavage of the fusion protein with thrombin.

Examples of suitable inducible non-fusion *E. coli* expression vectors include pTrc (Amann *et al.*, (1988) *Gene* 69:301-315) pLG338, pACYC184, pBR322, pUC18, pUC19, pKC30, pRep4, pHS1, pHS2, pPLc236, pMBL24, pLG200, pUR290, pIN-
25 III113-B1, λ gt11, pBdCl, and pET 11d (Studier *et al.*, *Gene Expression Technology: Methods in Enzymology* 185, Academic Press, San Diego, California (1990) 60-89; and Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York ISBN 0 444 904018). Target gene expression from the pTrc vector relies on host RNA polymerase transcription from a hybrid trp-lac fusion promoter. Target gene expression from the
30 pET 11d vector relies on transcription from a T7 gn10-lac fusion promoter mediated by a coexpressed viral RNA polymerase (T7 gn1). This viral polymerase is supplied by host strains BL21(DE3) or HMS174(DE3) from a resident λ prophage harboring a T7

gn1 gene under the transcriptional control of the lacUV 5 promoter. For transformation of other varieties of bacteria, appropriate vectors may be selected. For example, the plasmids pIJ101, pIJ364, pIJ702 and pIJ361 are known to be useful in transforming *Streptomyces*, while plasmids pUB110, pC194, or pBD214 are suited for transformation of *Bacillus* species. Several plasmids of use in the transfer of genetic information into *Corynebacterium* include pHM1519, pBL1, pSA77, or pAJ667 (Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York ISBN 0 444 904018).

One strategy to maximize recombinant protein expression is to express the protein in a host bacteria with an impaired capacity to proteolytically cleave the recombinant protein (Gottesman, S., *Gene Expression Technology: Methods in Enzymology* 185, Academic Press, San Diego, California (1990) 119-128). Another strategy is to alter the nucleic acid sequence of the nucleic acid to be inserted into an expression vector so that the individual codons for each amino acid are those preferentially utilized in the bacterium chosen for expression, such as *C. glutamicum* (Wada *et al.* (1992) *Nucleic Acids Res.* 20:2111-2118). Such alteration of nucleic acid sequences of the invention can be carried out by standard DNA synthesis techniques.

In another embodiment, the SRT protein expression vector is a yeast expression vector. Examples of vectors for expression in yeast *S. cerevisiae* include pYepSec1 (Baldari, *et al.*, (1987) *Embo J.* 6:229-234), 2 μ , pAG-1, Yep6, Yep13, pEMBLYe23, pMFa (Kurjan and Herskowitz, (1982) *Cell* 30:933-943), pJRY88 (Schultz *et al.*, (1987) *Gene* 54:113-123), and pYES2 (Invitrogen Corporation, San Diego, CA). Vectors and methods for the construction of vectors appropriate for use in other fungi, such as the filamentous fungi, include those detailed in: van den Hondel, C.A.M.J.J. & Punt, P.J. (1991) "Gene transfer systems and vector development for filamentous fungi, in: Applied Molecular Genetics of Fungi, J.F. Peberdy, *et al.*, eds., p. 1-28, Cambridge University Press: Cambridge, and Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York (ISBN 0 444 904018).

Alternatively, the SRT proteins of the invention can be expressed in insect cells using baculovirus expression vectors. Baculovirus vectors available for expression of proteins in cultured insect cells (*e.g.*, Sf 9 cells) include the pAc series (Smith *et al.* (1983) *Mol. Cell Biol.* 3:2156-2165) and the pVL series (Lucklow and Summers (1989) *Virology* 170:31-39).

In another embodiment, the SRT proteins of the invention may be expressed in unicellular plant cells (such as algae) or in plant cells from higher plants (e.g., the spermatophytes, such as crop plants). Examples of plant expression vectors include those detailed in: Becker, D., Kemper, E., Schell, J. and Masterson, R. (1992) "New
5 plant binary vectors with selectable markers located proximal to the left border", *Plant Mol. Biol.* 20: 1195-1197; and Bevan, M.W. (1984) "Binary *Agrobacterium* vectors for plant transformation", *Nucl. Acid. Res.* 12: 8711-8721, and include pLGV23, pGHIac+, pBIN19, pAK2004, and pDH51 (Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York ISBN 0 444 904018).

10 In yet another embodiment, a nucleic acid of the invention is expressed in mammalian cells using a mammalian expression vector. Examples of mammalian expression vectors include pCDM8 (Seed, B. (1987) *Nature* 329:840) and pMT2PC (Kaufman *et al.* (1987) *EMBO J.* 6:187-195). When used in mammalian cells, the expression vector's control functions are often provided by viral regulatory elements.
15 For example, commonly used promoters are derived from polyoma, Adenovirus 2, cytomegalovirus and Simian Virus 40. For other suitable expression systems for both prokaryotic and eukaryotic cells see chapters 16 and 17 of Sambrook, J., Fritsh, E. F., and Maniatis, T. *Molecular Cloning: A Laboratory Manual. 2nd, ed., Cold Spring Harbor Laboratory*, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY,
20 1989.

In another embodiment, the recombinant mammalian expression vector is capable of directing expression of the nucleic acid preferentially in a particular cell type (e.g., tissue-specific regulatory elements are used to express the nucleic acid). Tissue-specific regulatory elements are known in the art. Non-limiting examples of suitable
25 tissue-specific promoters include the albumin promoter (liver-specific; Pinkert *et al.* (1987) *Genes Dev.* 1:268-277), lymphoid-specific promoters (Calame and Eaton (1988) *Adv. Immunol.* 43:235-275), in particular promoters of T cell receptors (Winoto and Baltimore (1989) *EMBO J.* 8:729-733) and immunoglobulins (Banerji *et al.* (1983) *Cell* 33:729-740; Queen and Baltimore (1983) *Cell* 33:741-748), neuron-specific promoters
30 (e.g., the neurofilament promoter; Byrne and Ruddle (1989) *PNAS* 86:5473-5477), pancreas-specific promoters (Edlund *et al.* (1985) *Science* 230:912-916), and mammary gland-specific promoters (e.g., milk whey promoter; U.S. Patent No. 4,873,316 and

European Application Publication No. 264,166). Developmentally-regulated promoters are also encompassed, for example the murine hox promoters (Kessel and Gruss (1990) *Science* 249:374-379) and the α -fetoprotein promoter (Campes and Tilghman (1989) *Genes Dev.* 3:537-546).

5 The invention further provides a recombinant expression vector comprising a DNA molecule of the invention cloned into the expression vector in an antisense orientation. That is, the DNA molecule is operatively linked to a regulatory sequence in a manner which allows for expression (by transcription of the DNA molecule) of an RNA molecule which is antisense to SRT mRNA. Regulatory sequences operatively
10 linked to a nucleic acid cloned in the antisense orientation can be chosen which direct the continuous expression of the antisense RNA molecule in a variety of cell types, for instance viral promoters and/or enhancers, or regulatory sequences can be chosen which direct constitutive, tissue specific or cell type specific expression of antisense RNA. The antisense expression vector can be in the form of a recombinant plasmid, phagemid
15 or attenuated virus in which antisense nucleic acids are produced under the control of a high efficiency regulatory region, the activity of which can be determined by the cell type into which the vector is introduced. For a discussion of the regulation of gene expression using antisense genes see Weintraub, H. *et al.*, Antisense RNA as a molecular tool for genetic analysis, *Reviews - Trends in Genetics*, Vol. 1(1) 1986.

20 Another aspect of the invention pertains to host cells into which a recombinant expression vector of the invention has been introduced. The terms "host cell" and "recombinant host cell" are used interchangeably herein. It is understood that such terms refer not only to the particular subject cell but to the progeny or potential progeny of such a cell. Because certain modifications may occur in succeeding generations due
25 to either mutation or environmental influences, such progeny may not, in fact, be identical to the parent cell, but are still included within the scope of the term as used herein.

 A host cell can be any prokaryotic or eukaryotic cell. For example, an SRT protein can be expressed in bacterial cells such as *C. glutamicum*, insect cells, yeast or
30 mammalian cells (such as Chinese hamster ovary cells (CHO) or COS cells). Other suitable host cells are known to those of ordinary skill in the art. Microorganisms related

to *Corynebacterium glutamicum* which may be conveniently used as host cells for the nucleic acid and protein molecules of the invention are set forth in Table 3.

Vector DNA can be introduced into prokaryotic or eukaryotic cells via conventional transformation or transfection techniques. As used herein, the terms
5 "transformation" and "transfection" are intended to refer to a variety of art-recognized techniques for introducing foreign nucleic acid (*e.g.*, linear DNA or RNA (*e.g.*, a linearized vector or a gene construct alone without a vector) or nucleic acid in the form of a vector (*e.g.*, a plasmid, phage, phasmid, phagemid, transposon or other DNA)) into a host cell, including calcium phosphate or calcium chloride co-precipitation, DEAE-
10 dextran-mediated transfection, lipofection, or electroporation. Suitable methods for transforming or transfecting host cells can be found in Sambrook, *et al.* (*Molecular Cloning: A Laboratory Manual. 2nd, ed., Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989*), and other laboratory manuals.

For stable transfection of mammalian cells, it is known that, depending upon the
15 expression vector and transfection technique used, only a small fraction of cells may integrate the foreign DNA into their genome. In order to identify and select these integrants, a gene that encodes a selectable marker (*e.g.*, resistance to antibiotics) is generally introduced into the host cells along with the gene of interest. Preferred selectable markers include those which confer resistance to drugs, such as G418,
20 hygromycin and methotrexate. Nucleic acid encoding a selectable marker can be introduced into a host cell on the same vector as that encoding an SRT protein or can be introduced on a separate vector. Cells stably transfected with the introduced nucleic acid can be identified by drug selection (*e.g.*, cells that have incorporated the selectable marker gene will survive, while the other cells die).

25 To create a homologous recombinant microorganism, a vector is prepared which contains at least a portion of an SRT gene into which a deletion, addition or substitution has been introduced to thereby alter, *e.g.*, functionally disrupt, the SRT gene. Preferably, this SRT gene is a *Corynebacterium glutamicum* SRT gene, but it can be a homologue from a related bacterium or even from a mammalian, yeast, or insect source.
30 In a preferred embodiment, the vector is designed such that, upon homologous recombination, the endogenous SRT gene is functionally disrupted (*i.e.*, no longer encodes a functional protein; also referred to as a "knock out" vector). Alternatively,

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the vector can be designed such that, upon homologous recombination, the endogenous SRT gene is mutated or otherwise altered but still encodes functional protein (*e.g.*, the upstream regulatory region can be altered to thereby alter the expression of the endogenous SRT protein). In the homologous recombination vector, the altered portion
5 of the SRT gene is flanked at its 5' and 3' ends by additional nucleic acid of the SRT gene to allow for homologous recombination to occur between the exogenous SRT gene carried by the vector and an endogenous SRT gene in a microorganism. The additional flanking SRT nucleic acid is of sufficient length for successful homologous recombination with the endogenous gene. Typically, several kilobases of flanking DNA
10 (both at the 5' and 3' ends) are included in the vector (see *e.g.*, Thomas, K.R., and Capecchi, M.R. (1987) *Cell* 51: 503 for a description of homologous recombination vectors). The vector is introduced into a microorganism (*e.g.*, by electroporation) and cells in which the introduced SRT gene has homologously recombined with the endogenous SRT gene are selected, using art-known techniques.

15 In another embodiment, recombinant microorganisms can be produced which contain selected systems which allow for regulated expression of the introduced gene. For example, inclusion of an SRT gene on a vector placing it under control of the *lac* operon permits expression of the SRT gene only in the presence of IPTG. Such regulatory systems are well known in the art.

20 In another embodiment, an endogenous SRT gene in a host cell is disrupted (*e.g.*, by homologous recombination or other genetic means known in the art) such that expression of its protein product does not occur. In another embodiment, an endogenous or introduced SRT gene in a host cell has been altered by one or more point mutations, deletions, or inversions, but still encodes a functional SRT protein. In still another
25 embodiment, one or more of the regulatory regions (*e.g.*, a promoter, repressor, or inducer) of an SRT gene in a microorganism has been altered (*e.g.*, by deletion, truncation, inversion, or point mutation) such that the expression of the SRT gene is modulated. One of ordinary skill in the art will appreciate that host cells containing more than one of the described SRT gene and protein modifications may be readily
30 produced using the methods of the invention, and are meant to be included in the present invention.

A host cell of the invention, such as a prokaryotic or eukaryotic host cell in culture, can be used to produce (*i.e.*, express) an SRT protein. Accordingly, the invention further provides methods for producing SRT proteins using the host cells of the invention. In one embodiment, the method comprises culturing the host cell of
5 invention (into which a recombinant expression vector encoding an SRT protein has been introduced, or into which genome has been introduced a gene encoding a wild-type or altered SRT protein) in a suitable medium until SRT protein is produced. In another embodiment, the method further comprises isolating SRT proteins from the medium or the host cell.

10

C. Isolated SRT Proteins

Another aspect of the invention pertains to isolated SRT proteins, and biologically active portions thereof. An "isolated" or "purified" protein or biologically active portion thereof is substantially free of cellular material when produced by
15 recombinant DNA techniques, or chemical precursors or other chemicals when chemically synthesized. The language "substantially free of cellular material" includes preparations of SRT protein in which the protein is separated from cellular components of the cells in which it is naturally or recombinantly produced. In one embodiment, the language "substantially free of cellular material" includes preparations of SRT protein
20 having less than about 30% (by dry weight) of non-SRT protein (also referred to herein as a "contaminating protein"), more preferably less than about 20% of non-SRT protein, still more preferably less than about 10% of non-SRT protein, and most preferably less than about 5% non-SRT protein. When the SRT protein or biologically active portion thereof is recombinantly produced, it is also preferably substantially free of culture
25 medium, *i.e.*, culture medium represents less than about 20%, more preferably less than about 10%, and most preferably less than about 5% of the volume of the protein preparation. The language "substantially free of chemical precursors or other chemicals" includes preparations of SRT protein in which the protein is separated from chemical precursors or other chemicals which are involved in the synthesis of the
30 protein. In one embodiment, the language "substantially free of chemical precursors or other chemicals" includes preparations of SRT protein having less than about 30% (by dry weight) of chemical precursors or non-SRT chemicals, more preferably less than

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about 20% chemical precursors or non-SRT chemicals, still more preferably less than about 10% chemical precursors or non-SRT chemicals, and most preferably less than about 5% chemical precursors or non-SRT chemicals. In preferred embodiments, isolated proteins or biologically active portions thereof lack contaminating proteins from the same organism from which the SRT protein is derived. Typically, such proteins are produced by recombinant expression of, for example, a *C. glutamicum* SRT protein in a microorganism such as *C. glutamicum*.

An isolated SRT protein or a portion thereof of the invention can contribute to the resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses or hazards, or has one or more of the activities set forth in Table 1. In preferred embodiments, the protein or portion thereof comprises an amino acid sequence which is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) such that the protein or portion thereof maintains the ability to mediate the resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses or hazards. The portion of the protein is preferably a biologically active portion as described herein. In another preferred embodiment, an SRT protein of the invention has an amino acid sequence set forth as an even-numbered SEQ ID NO: of the Sequence Listing. In yet another preferred embodiment, the SRT protein has an amino acid sequence which is encoded by a nucleotide sequence which hybridizes, *e.g.*, hybridizes under stringent conditions, to a nucleotide sequence of the invention (*e.g.*, a sequence of an odd-numbered SEQ ID NO: of the Sequence Listing). In still another preferred embodiment, the SRT protein has an amino acid sequence which is encoded by a nucleotide sequence that is at least about 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more homologous to one of the nucleic acid sequences of the invention, or a portion thereof. Ranges and identity values intermediate to the above-recited values, (*e.g.*, 70-90% identical or 80-95% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper

and/or lower limits are intended to be included. The preferred SRT proteins of the present invention also preferably possess at least one of the SRT activities described herein. For example, a preferred SRT protein of the present invention includes an amino acid sequence encoded by a nucleotide sequence which hybridizes, *e.g.*, hybridizes
5 under stringent conditions, to a nucleotide sequence of the invention, and which can increase the resistance or tolerance of *C. glutamicum* to one or more environmental or chemical stresses, or which has one or more of the activities set forth in Table 1.

In other embodiments, the SRT protein is substantially homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of
10 the Sequence Listing) and retains the functional activity of the protein of one of the amino acid sequences of the invention yet differs in amino acid sequence due to natural variation or mutagenesis, as described in detail in subsection I above. Accordingly, in another embodiment, the SRT protein is a protein which comprises an amino acid sequence which is at least about 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%,
15 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more homologous to an entire amino acid sequence of the invention and which
20 has at least one of the SRT activities described herein. Ranges and identity values intermediate to the above-recited values, (*e.g.*, 70-90% identical or 80-95% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower limits are intended to be included. In another embodiment, the invention pertains
25 to a full length *C. glutamicum* protein which is substantially homologous to an entire amino acid sequence of the invention.

Biologically active portions of an SRT protein include peptides comprising amino acid sequences derived from the amino acid sequence of an SRT protein, *e.g.*, an amino acid sequence of an even-numbered SEQ ID NO: of the Sequence Listing or the
30 amino acid sequence of a protein homologous to an SRT protein, which include fewer amino acids than a full length SRT protein or the full length protein which is homologous to an SRT protein, and exhibit at least one activity of an SRT protein.

Typically, biologically active portions (peptides, *e.g.*, peptides which are, for example, 5, 10, 15, 20, 30, 35, 36, 37, 38, 39, 40, 50, 100 or more amino acids in length) comprise a domain or motif with at least one activity of an SRT protein. Moreover, other biologically active portions, in which other regions of the protein are deleted, can be prepared by recombinant techniques and evaluated for one or more of the activities described herein. Preferably, the biologically active portions of an SRT protein include one or more selected domains/motifs or portions thereof having biological activity.

SRT proteins are preferably produced by recombinant DNA techniques. For example, a nucleic acid molecule encoding the protein is cloned into an expression vector (as described above), the expression vector is introduced into a host cell (as described above) and the SRT protein is expressed in the host cell. The SRT protein can then be isolated from the cells by an appropriate purification scheme using standard protein purification techniques. Alternative to recombinant expression, an SRT protein, polypeptide, or peptide can be synthesized chemically using standard peptide synthesis techniques. Moreover, native SRT protein can be isolated from cells (*e.g.*, endothelial cells), for example using an anti-SRT antibody, which can be produced by standard techniques utilizing an SRT protein or fragment thereof of this invention.

The invention also provides SRT chimeric or fusion proteins. As used herein, an SRT "chimeric protein" or "fusion protein" comprises an SRT polypeptide operatively linked to a non-SRT polypeptide. An "SRT polypeptide" refers to a polypeptide having an amino acid sequence corresponding to SRT, whereas a "non-SRT polypeptide" refers to a polypeptide having an amino acid sequence corresponding to a protein which is not substantially homologous to the SRT protein, *e.g.*, a protein which is different from the SRT protein and which is derived from the same or a different organism. Within the fusion protein, the term "operatively linked" is intended to indicate that the SRT polypeptide and the non-SRT polypeptide are fused in-frame to each other. The non-SRT polypeptide can be fused to the N-terminus or C-terminus of the SRT polypeptide. For example, in one embodiment the fusion protein is a GST-SRT fusion protein in which the SRT sequences are fused to the C-terminus of the GST sequences. Such fusion proteins can facilitate the purification of recombinant SRT proteins. In another embodiment, the fusion protein is an SRT protein containing a heterologous signal sequence at its N-terminus. In certain host cells (*e.g.*, mammalian host cells), expression

and/or secretion of an SRT protein can be increased through use of a heterologous signal sequence.

Preferably, an SRT chimeric or fusion protein of the invention is produced by standard recombinant DNA techniques. For example, DNA fragments coding for the
5 different polypeptide sequences are ligated together in-frame in accordance with conventional techniques, for example by employing blunt-ended or stagger-ended termini for ligation, restriction enzyme digestion to provide for appropriate termini, filling-in of cohesive ends as appropriate, alkaline phosphatase treatment to avoid undesirable joining, and enzymatic ligation. In another embodiment, the fusion gene
10 can be synthesized by conventional techniques including automated DNA synthesizers. Alternatively, PCR amplification of gene fragments can be carried out using anchor primers which give rise to complementary overhangs between two consecutive gene fragments which can subsequently be annealed and reamplified to generate a chimeric gene sequence (see, for example, *Current Protocols in Molecular Biology*, eds. Ausubel
15 *et al.* John Wiley & Sons: 1992). Moreover, many expression vectors are commercially available that already encode a fusion moiety (*e.g.*, a GST polypeptide). An SRT-encoding nucleic acid can be cloned into such an expression vector such that the fusion moiety is linked in-frame to the SRT protein.

Homologues of the SRT protein can be generated by mutagenesis, *e.g.*, discrete
20 point mutation or truncation of the SRT protein. As used herein, the term "homologue" refers to a variant form of the SRT protein which acts as an agonist or antagonist of the activity of the SRT protein. An agonist of the SRT protein can retain substantially the same, or a subset, of the biological activities of the SRT protein. An antagonist of the SRT protein can inhibit one or more of the activities of the naturally occurring form of
25 the SRT protein, by, for example, competitively binding to a downstream or upstream member of the SRT system which includes the SRT protein. Thus, the *C. glutamicum* SRT protein and homologues thereof of the present invention may increase the tolerance or resistance of *C. glutamicum* to one or more chemical or environmental stresses.

In an alternative embodiment, homologues of the SRT protein can be identified
30 by screening combinatorial libraries of mutants, *e.g.*, truncation mutants, of the SRT protein for SRT protein agonist or antagonist activity. In one embodiment, a variegated library of SRT variants is generated by combinatorial mutagenesis at the nucleic acid

level and is encoded by a variegated gene library. A variegated library of SRT variants can be produced by, for example, enzymatically ligating a mixture of synthetic oligonucleotides into gene sequences such that a degenerate set of potential SRT sequences is expressible as individual polypeptides, or alternatively, as a set of larger fusion proteins (*e.g.*, for phage display) containing the set of SRT sequences therein. There are a variety of methods which can be used to produce libraries of potential SRT homologues from a degenerate oligonucleotide sequence. Chemical synthesis of a degenerate gene sequence can be performed in an automatic DNA synthesizer, and the synthetic gene then ligated into an appropriate expression vector. Use of a degenerate set of genes allows for the provision, in one mixture, of all of the sequences encoding the desired set of potential SRT sequences. Methods for synthesizing degenerate oligonucleotides are known in the art (see, *e.g.*, Narang, S.A. (1983) *Tetrahedron* 39:3; Itakura *et al.* (1984) *Annu. Rev. Biochem.* 53:323; Itakura *et al.* (1984) *Science* 198:1056; Ike *et al.* (1983) *Nucleic Acid Res.* 11:477.

15 In addition, libraries of fragments of the SRT protein coding can be used to generate a variegated population of SRT fragments for screening and subsequent selection of homologues of an SRT protein. In one embodiment, a library of coding sequence fragments can be generated by treating a double stranded PCR fragment of an SRT coding sequence with a nuclease under conditions wherein nicking occurs only about once per molecule, denaturing the double stranded DNA, renaturing the DNA to form double stranded DNA which can include sense/antisense pairs from different nicked products, removing single stranded portions from reformed duplexes by treatment with S1 nuclease, and ligating the resulting fragment library into an expression vector. By this method, an expression library can be derived which encodes N-terminal, 20 C-terminal and internal fragments of various sizes of the SRT protein.

Several techniques are known in the art for screening gene products of combinatorial libraries made by point mutations or truncation, and for screening cDNA libraries for gene products having a selected property. Such techniques are adaptable for rapid screening of the gene libraries generated by the combinatorial mutagenesis of SRT homologues. The most widely used techniques, which are amenable to high through-put analysis, for screening large gene libraries typically include cloning the gene library into replicable expression vectors, transforming appropriate cells with the resulting library of 30

vectors, and expressing the combinatorial genes under conditions in which detection of a desired activity facilitates isolation of the vector encoding the gene whose product was detected. Recursive ensemble mutagenesis (REM), a new technique which enhances the frequency of functional mutants in the libraries, can be used in combination with the
5 screening assays to identify SRT homologues (Arkin and Yourvan (1992) *PNAS* 89:7811-7815; Delgrave *et al.* (1993) *Protein Engineering* 6(3):327-331).

In another embodiment, cell based assays can be exploited to analyze a variegated SRT library, using methods well known in the art.

10 *D. Uses and Methods of the Invention*

The nucleic acid molecules, proteins, protein homologues, fusion proteins, primers, vectors, and host cells described herein can be used in one or more of the following methods: identification of *C. glutamicum* and related organisms; mapping of genomes of organisms related to *C. glutamicum*; identification and localization of *C.*
15 *glutamicum* sequences of interest; evolutionary studies; determination of SRT protein regions required for function; modulation of an SRT protein activity; modulation of the activity of an SRT pathway; and modulation of cellular production of a desired compound, such as a fine chemical.

The SRT nucleic acid molecules of the invention have a variety of uses. First,
20 they may be used to identify an organism as being *Corynebacterium glutamicum* or a close relative thereof. Also, they may be used to identify the presence of *C. glutamicum* or a relative thereof in a mixed population of microorganisms. The invention provides the nucleic acid sequences of a number of *C. glutamicum* genes; by probing the extracted genomic DNA of a culture of a unique or mixed population of microorganisms
25 under stringent conditions with a probe spanning a region of a *C. glutamicum* gene which is unique to this organism, one can ascertain whether this organism is present.

Although *Corynebacterium glutamicum* itself is nonpathogenic, it is related to pathogenic species, such as *Corynebacterium diphtheriae*. *Corynebacterium diphtheriae* is the causative agent of diphtheria, a rapidly developing, acute, febrile infection which
30 involves both local and systemic pathology. In this disease, a local lesion develops in the upper respiratory tract and involves necrotic injury to epithelial cells; the bacilli secrete toxin which is disseminated through this lesion to distal susceptible tissues of the

body. Degenerative changes brought about by the inhibition of protein synthesis in these tissues, which include heart, muscle, peripheral nerves, adrenals, kidneys, liver and spleen, result in the systemic pathology of the disease. Diphtheria continues to have high incidence in many parts of the world, including Africa, Asia, Eastern Europe and the independent states of the former Soviet Union. An ongoing epidemic of diphtheria in the latter two regions has resulted in at least 5,000 deaths since 1990.

In one embodiment, the invention provides a method of identifying the presence or activity of *Corynebacterium diphtheriae* in a subject. This method includes detection of one or more of the nucleic acid or amino acid sequences of the invention (*e.g.*, the sequences set forth as odd-numbered or even-numbered SEQ ID NOs, respectively, in the Sequence Listing) in a subject, thereby detecting the presence or activity of *Corynebacterium diphtheriae* in the subject. *C. glutamicum* and *C. diphtheriae* are related bacteria, and many of the nucleic acid and protein molecules in *C. glutamicum* are homologous to *C. diphtheriae* nucleic acid and protein molecules, and can therefore be used to detect *C. diphtheriae* in a subject.

The nucleic acid and protein molecules of the invention may also serve as markers for specific regions of the genome. This has utility not only in the mapping of the genome, but also for functional studies of *C. glutamicum* proteins. For example, to identify the region of the genome to which a particular *C. glutamicum* DNA-binding protein binds, the *C. glutamicum* genome could be digested, and the fragments incubated with the DNA-binding protein. Those which bind the protein may be additionally probed with the nucleic acid molecules of the invention, preferably with readily detectable labels; binding of such a nucleic acid molecule to the genome fragment enables the localization of the fragment to the genome map of *C. glutamicum*, and, when performed multiple times with different enzymes, facilitates a rapid determination of the nucleic acid sequence to which the protein binds. Further, the nucleic acid molecules of the invention may be sufficiently homologous to the sequences of related species such that these nucleic acid molecules may serve as markers for the construction of a genomic map in related bacteria, such as *Brevibacterium lactofermentum*.

The SRT nucleic acid molecules of the invention are also useful for evolutionary and protein structural studies. The resistance processes in which the molecules of the invention participate are utilized by a wide variety of cells; by comparing the sequences

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of the nucleic acid molecules of the present invention to those encoding similar enzymes from other organisms, the evolutionary relatedness of the organisms can be assessed. Similarly, such a comparison permits an assessment of which regions of the sequence are conserved and which are not, which may aid in determining those regions of the protein which are essential for the functioning of the enzyme. This type of determination is of value for protein engineering studies and may give an indication of what the protein can tolerate in terms of mutagenesis without losing function.

The genes of the invention, *e.g.*, the gene encoding LMRB (SEQ ID NO:1) or other gene of the invention encoding a chemical or environmental resistance or tolerance protein (*e.g.*, resistance against one or more antibiotics), may be used as genetic markers for the genetic transformation of (*e.g.*, the transfer of additional genes into or disruption of preexisting genes of) organisms such as *C. glutamicum* or other bacterial species. Use of these nucleic acid molecules permits efficient selection of organisms which have incorporated a given transgene cassette (*e.g.*, a plasmid, phage, phasmid, phagemid, transposon, or other nucleic acid element), based on a trait which permits the survival of the organism in an otherwise hostile or toxic environment (*e.g.*, in the presence of an antimicrobial compound). By employing one or more of the genes of the invention as genetic markers, the speed and ease with which organisms having desirable transformed traits (*e.g.*, modulated fine chemical production) are engineered and isolated are improved. While it is advantageous to use the genes of the invention for selection of transformed *C. glutamicum* and related bacteria, it is possible, as described herein, to use homologs (*e.g.*, homologs from other organisms), allelic variants or fragments of the gene retaining desired activity. Furthermore, 5' and 3' regulatory elements of the genes of the invention may be modified as described herein (*e.g.*, by nucleotide substitution, insertion, deletion, or replacement with a more desirable genetic element) to modulate the transcription of the gene. For example, an LMRB variant in which the nucleotide sequence in the region from -1 to -200 5' to the start codon has been altered to modulate (preferably increase) the transcription and/or translation of LMRB may be employed, as can constructs in which a gene of the invention (*e.g.*, the LMRB gene (SEQ ID NO:1)) is functionally coupled to one or more regulatory signals (*e.g.*, inducer or repressor binding sequences) which can be used for modulating gene expression.

Similarly, more than one copy of a gene (functional or inactivated) of the invention may be employed.

An additional application of the genes of the invention (*e.g.*, the gene encoding LMRB (SEQ ID NO:1) or other drug- or antibiotic-resistance gene) is in the discovery
5 of new antibiotics which are active against *Corynebacteria* and/or other bacteria. For example, a gene of the invention may be expressed (or overexpressed) in a suitable host to generate an organism with increased resistance to one or more drugs or antibiotics (in the case of LMRB, lincosamides in particular, especially lincomycin). This type of resistant host can subsequently be used to screen for chemicals with bacteriostatic and/or
10 bacteriocidal activity, such as novel antibiotic compounds. It is possible, in particular, to use the genes of the invention (*e.g.*, the LMRB gene) to identify new antibiotics which are active against those microorganisms which are already resistant to standard antibiotic compounds.

The invention provides methods for screening molecules which modulate the
15 activity of an SRT protein, either by interacting with the protein itself or a substrate or binding partner of the SRT protein, or by modulating the transcription or translation of SRT nucleic acid molecule of the invention. In such methods, a microorganism expressing one or more SRT proteins of the invention is contacted with one or more test compounds, and the effect of each test compound on the activity or level of expression
20 of the SRT protein is assessed.

Manipulation of the SRT nucleic acid molecules of the invention may result in the production of SRT proteins having functional differences from the wild-type SRT proteins. These proteins may be improved in efficiency or activity, may be present in greater numbers in the cell than is usual, or may be decreased in efficiency or activity.
25 The goal of such manipulations is to increase the viability and activity of the cell when the cell is exposed to the environmental and chemical stresses and hazards which frequently accompany large-scale fermentative culture. Thus, by increasing the activity or copy number of a heat-shock-regulated protease, one may increase the ability of the cell to destroy incorrectly folded proteins, which may otherwise interfere with normal
30 cellular functioning (for example, by continuing to bind substrates or cofactors although the protein lacks the activity to act on these molecules appropriately). The same is true for the overexpression or optimization of activity of one or more chaperone molecules

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induced by heat or cold shock. These proteins aid in the correct folding of nascent polypeptide chains, and thus their increased activity or presence should increase the percentage of correctly folded proteins in the cell, which in turn should increase the overall metabolic efficiency and viability of the cells in culture. The overexpression or
5 optimization of the transporter molecules activated by osmotic shock should result in an increased ability on the part of the cell to maintain intracellular homeostasis, thereby increasing the viability of these cells in culture. Similarly, the overproduction or increase in activity by mutagenesis of proteins involved in the development of cellular resistance to chemical stresses of various kinds (either by transport of the offending
10 chemical out of the cell or by modification of the chemical to a less hazardous substance) should increase the fitness of the organism in the environment containing the hazardous substance (*i.e.*, large-scale fermentative culture), and thereby may permit relatively larger numbers of cells to survive in such a culture. The net effect of all of these mutagenesis strategies is to increase the quantity of fine-chemical-producing
15 compounds in the culture, thereby increasing the yield, production, and/or efficiency of production of one or more desired fine chemicals from the culture.

This aforementioned list of mutagenesis strategies for SRT proteins to result in increased yields of a desired compound is not meant to be limiting; variations on these mutagenesis strategies will be readily apparent to one of ordinary skill in the art. By
20 these mechanisms, the nucleic acid and protein molecules of the invention may be utilized to generate *C. glutamicum* or related strains of bacteria expressing mutated SRT nucleic acid and protein molecules such that the yield, production, and/or efficiency of production of a desired compound is improved. This desired compound may be any natural product of *C. glutamicum*, which includes the final products of biosynthesis
25 pathways and intermediates of naturally-occurring metabolic pathways, as well as molecules which do not naturally occur in the metabolism of *C. glutamicum*, but which are produced by a *C. glutamicum* strain of the invention.

This invention is further illustrated by the following examples which should not be construed as limiting. The contents of all references, patent applications, patents,
30 published patent applications, Tables, and the sequence listing cited throughout this application are hereby incorporated by reference.

TABLE 1: Genes Included in the Application

| Nucleic Acid SEQ ID NO | Amino Acid SEQ ID NO | Identification Code | Contig. | NT Start | NT Stop | Function |
|---------------------------|-------------------------|---------------------|---------|----------|---------|---|
| 1 | 2 | RXA01524 | GR00424 | 29041 | 30483 | Lincomycine RESISTANCE PROTEIN |
| 3 | 4 | RXA00497 | GR00124 | 52 | 348 | 10 KD CHAPERONIN |
| 5 | 6 | RXN00493 | VV0086 | 14389 | 16002 | 60 KD CHAPERONIN |
| 7 | 8 | F RXA00498 | GR00124 | 363 | 1601 | 60 KD CHAPERONIN |
| 9 | 10 | RXA01217 | GR00353 | 802 | 203 | GENERAL STRESS PROTEIN CTC |
| 11 | 12 | RXA00605 | GR00159 | 7412 | 5865 | CATALASE (EC 1.11.1.6) |
| 13 | 14 | RXA00404 | GR00089 | 2909 | 594 | CARBON STARVATION PROTEIN A |
| 15 | 16 | RXN03119 | VV0098 | 86877 | 87008 | SUPEROXIDE DISMUTASE [MN] (EC 1.15.1.1) |
| 17 | 18 | RXN03120 | VV0098 | 87351 | 87476 | SUPEROXIDE DISMUTASE [MN] (EC 1.15.1.1) |
| 19 | 20 | RXN00575 | VV0323 | 14716 | 15252 | PHOSPHINOTHRICIN-RESISTANCE PROTEIN |
| 21 | 22 | F RXA00575 | GR00156 | 2130 | 1648 | PHOSPHINOTHRICIN-RESISTANCE PROTEIN |

Chaperones

| Nucleic Acid SEQ ID NO | Amino Acid SEQ ID NO | Identification Code | Contig. | NT Start | NT Stop | Function |
|---------------------------|-------------------------|---------------------|---------|----------|---------|--|
| 23 | 24 | RXN01345 | VV0123 | 4883 | 3432 | Molecular chaperon (HSP70/DnaK family) |
| 25 | 26 | F RXA01345 | GR00391 | 1172 | 6 | Molecular chaperones (HSP70/DnaK family) |
| 27 | 28 | RXA02541 | GR00726 | 13657 | 12473 | DNAJ PROTEIN |
| 29 | 30 | RXA02542 | GR00726 | 14518 | 13865 | GRPE PROTEIN |
| 31 | 32 | RXN02543 | VV0057 | 22031 | 20178 | DNAK PROTEIN |
| 33 | 34 | F RXA02543 | GR00726 | 16375 | 14522 | DNAK PROTEIN |
| 35 | 36 | RXN02280 | VV0152 | 1849 | 26 | TRAP1 |
| 37 | 38 | F RXA02282 | GR00659 | 1145 | 1480 | Molecular chaperone, HSP90 family |
| 39 | 40 | RXA00886 | GR00242 | 12396 | 13541 | DNAJ PROTEIN |
| 41 | 42 | RXS00568 | VV0251 | 2928 | 1582 | TRIGGER FACTOR |
| 43 | 44 | RXN03038 | VV0017 | 42941 | 43666 | PS1 PROTEIN VORLÄUFER |
| 45 | 46 | RXN03039 | VV0018 | 2 | 631 | PS1 PROTEIN VORLÄUFER |
| 47 | 48 | RXN03040 | VV0018 | 761 | 1069 | PS1 PROTEIN VORLÄUFER |
| 49 | 50 | RXN03051 | VV0022 | 2832 | 3566 | PS1 PROTEIN VORLÄUFER |
| 51 | 52 | RXN03054 | VV0026 | 1906 | 3486 | PS1 PROTEIN VORLÄUFER |
| 53 | 54 | RXN02949 | VV0025 | 31243 | 31575 | PREPROTEIN TRANSLOKASE SECE UNTEREINHEIT |
| 55 | 56 | RXN02462 | VV0124 | 11932 | 13749 | PREPROTEIN TRANSLOKASE SECA UNTEREINHEIT |
| 57 | 58 | RXN01559 | VV0171 | 7795 | 5954 | PROTEIN-EXPORT MEMBRANE PROTEIN SECD |
| 59 | 60 | RXN00046 | VV0119 | 5363 | 6058 | Signal Erkennung particle GTPase |
| 61 | 62 | RXN01863 | VV0206 | 1172 | 24 | /O/C Thioredoxin-ähnliche oxidoreductase |
| 63 | 64 | RXN00833 | VV0180 | 8039 | 8533 | THIOL PEROXIDASE (EC 1.11.1.-) |

Table 1 (continued)

| <u>Nucleic Acid SEQ ID NO</u> | <u>Amino Acid SEQ ID NO</u> | <u>Identification Code</u> | <u>Contig.</u> | <u>NT Start</u> | <u>NT Stop</u> | <u>Function</u> |
|-----------------------------------|---------------------------------|----------------------------|----------------|-----------------|----------------|--|
| 65 | 66 | RXN01676 | VW0179 | 12059 | 11304 | THIOL:DISULFIDE AUSTAUSCH PROTEIN DSBD |
| 67 | 68 | RXN00380 | VW0223 | 836 | 216 | THIOL:DISULFIDE AUSTAUSCH PROTEIN TLPA |
| 69 | 70 | RXN00937 | VW0079 | 42335 | 42706 | THIOREDOXIN |
| 71 | 72 | RXN02325 | VW0047 | 5527 | 6393 | THIOREDOXIN |
| 73 | 74 | RXN01837 | VW0320 | 7103 | 7879 | PEPTIDYL-PROLYL CIS-TRANS ISOMERASE (EC 5.2.1.8) |
| 75 | 76 | RXN01926 | VW0284 | 1 | 741 | PEPTID KETTE RELEASE FACTOR 3 |
| 77 | 78 | RXN02002 | VW0111 | 141 | 518 | PEPTID KETTE RELEASE FACTOR 3 |
| 79 | 80 | RXN02736 | VW0074 | 13600 | 14556 | PUTATIVES OXPPCYCLE PROTEIN OPCA |
| 81 | 82 | RXS03217 | | | | SMALL COLD-SHOCK PROTEIN |
| 83 | 84 | F RXA01917 | GR00549 | 3465 | 3665 | SMALL COLD-SHOCK PROTEIN |

Proteins involved in stress responses

| <u>Nucleic Acid SEQ ID NO</u> | <u>Amino Acid SEQ ID NO</u> | <u>Identification Code</u> | <u>Contig.</u> | <u>NT Start</u> | <u>NT Stop</u> | <u>Function</u> |
|-----------------------------------|---------------------------------|----------------------------|----------------|-----------------|----------------|---|
| 85 | 86 | RXA02184 | GR00641 | 19628 | 19248 | COLD SHOCK-LIKE PROTEIN CSPC |
| 87 | 88 | RXA00810 | GR00218 | 792 | 992 | SMALL COLD-SHOCK PROTEIN |
| 89 | 90 | RXA01674 | GR00467 | 1878 | 2771 | PROBABLE HYDROGEN PEROXIDE-INDUCIBLE GENES ACTIVATOR |
| 91 | 92 | RXA02431 | GR00708 | 2 | 1192 | damage-inducible protein P |
| 93 | 94 | RXA02446 | GR00709 | 11640 | 11206 | OSMOTICALLY INDUCIBLE PROTEIN C |
| 95 | 96 | RXA02861 | GR10006 | 551 | 1633 | probable metallothionein u0308aa - Mycobacterium leprae |
| 97 | 98 | RXA00981 | GR00276 | 3388 | 4017 | GTP PYROPHOSPHOKINASE (EC 2.7.6.5) |
| 99 | 100 | RXN00786 | VW0321 | 1680 | 706 | LYTB PROTEIN |
| 101 | 102 | RXS01027 | VW0143 | 5761 | 6768 | DIADENOSINE 5',5'''-P1,P4-TETRAPHOSPHATE HYDROLASE (EC 3.6.1.17) |
| 103 | 104 | RXS01528 | VW0050 | 17276 | 16749 | DIADENOSINE 5',5'''-P1,P4-TETRAPHOSPHATE HYDROLASE (EC 3.6.1.17) |
| 105 | 106 | RXS01716 | VW0319 | 3259 | 2774 | EXOPOLYPHOSPHATASE (EC 3.6.1.11) |
| 107 | 108 | RXS01835 | VW0143 | 10575 | 10045 | GUANOSINE-3',5'-BIS(DIPHOSPHATE) 3'-PYROPHOSPHOHYDROLASE (EC 3.1.7.2) |
| 109 | 110 | RXS02497 | VW0007 | 15609 | 16535 | EXOPOLYPHOSPHATASE (EC 3.6.1.11) |
| 111 | 112 | RXS02972 | VW0319 | 2763 | 2353 | EXOPOLYPHOSPHATASE (EC 3.6.1.11) |

Resistance and tolerance

| <u>Nucleic Acid SEQ ID NO</u> | <u>Amino Acid SEQ ID NO</u> | <u>Identification Code</u> | <u>Contig.</u> | <u>NT Start</u> | <u>NT Stop</u> | <u>Function</u> |
|-----------------------------------|---------------------------------|----------------------------|----------------|-----------------|----------------|--|
| 113 | 114 | RXA02159 | GR00640 | 6231 | 6743 | ARGININE HYDROXIMATE RESISTANCE PROTEIN |
| 115 | 116 | RXA02201 | GR00646 | 5837 | 6199 | ARSENATE REDUCTASE |
| 117 | 118 | RXA00599 | GR00159 | 1843 | 1457 | ARSENICAL-RESISTANCE PROTEIN ACR3 |
| 119 | 120 | RXA00600 | GR00159 | 2940 | 1843 | ARSENICAL-RESISTANCE PROTEIN ACR3 |
| 121 | 122 | RXA02200 | GR00646 | 4651 | 5760 | ARSENICAL-RESISTANCE PROTEIN ACR3 |
| 123 | 124 | RXA02202 | GR00646 | 6278 | 6916 | ARSENICAL-RESISTANCE PROTEIN ACR3 |
| 125 | 126 | RXA02205 | GR00646 | 9871 | 8993 | BACITRACIN RESISTANCE PROTEIN (PUTATIVE UNDECAPRENOL KINASE) (EC 2.7.1.66) |
| 127 | 128 | RXA00900 | GR00245 | 4052 | 3201 | BICYCLOMYCIN RESISTANCE PROTEIN |

Table 1 (continued)

| Nucleic Acid SEQ ID NO | Amino Acid SEQ ID NO | Identification Code | Contig. | NT Start | NT Stop | Function |
|---------------------------|-------------------------|---------------------|---------|----------|---------|--|
| 129 | 130 | RXN00901 | VV0140 | 8581 | 8168 | BICYCLOMYCIN RESISTANCE PROTEIN |
| 131 | 132 | F RXA00901 | GR00245 | 4357 | 3980 | BICYCLOMYCIN RESISTANCE PROTEIN |
| 133 | 134 | RXA00289 | GR00046 | 3263 | 4438 | CHLORAMPHENICOL RESISTANCE PROTEIN |
| 135 | 136 | RXN01984 | VV0056 | 1515 | 1811 | CHLORAMPHENICOL RESISTANCE PROTEIN |
| 137 | 138 | F RXA01984 | GR00574 | 282 | 4 | CHLORAMPHENICOL RESISTANCE PROTEIN |
| 139 | 140 | RXA00109 | GR00015 | 1176 | 565 | COPPER RESISTANCE PROTEIN C PRECURSOR |
| 141 | 142 | RXA00109 | GR00015 | 1176 | 565 | COPPER RESISTANCE PROTEIN C PRECURSOR |
| 143 | 144 | RXA00996 | GR00283 | 1763 | 1023 | DAUNORUBICIN RESISTANCE ATP-BINDING PROTEIN DRRA |
| 145 | 146 | RXN00829 | VV0180 | 7950 | 5611 | DAUNORUBICIN RESISTANCE PROTEIN |
| 147 | 148 | F RXA00829 | GR00224 | 2 | 256 | DAUNORUBICIN RESISTANCE PROTEIN |
| 149 | 150 | F RXA00834 | GR00225 | 463 | 2025 | DAUNORUBICIN RESISTANCE PROTEIN |
| 151 | 152 | RXA00995 | GR00283 | 1023 | 283 | DAUNORUBICIN RESISTANCE TRANSMEMBRANE PROTEIN |
| 153 | 154 | RXN00803 | VV0009 | 53858 | 52629 | METHYLENOMYCIN A RESISTANCE PROTEIN |
| 155 | 156 | F RXA00803 | GR00214 | 4560 | 5162 | METHYLENOMYCIN A RESISTANCE PROTEIN |
| 157 | 158 | RXA01407 | GR00410 | 3918 | 3028 | METHYLENOMYCIN A RESISTANCE PROTEIN |
| 159 | 160 | RXA01408 | GR00410 | 4384 | 4184 | METHYLENOMYCIN A RESISTANCE PROTEIN |
| 161 | 162 | RXN01922 | VV0020 | 2031 | 3182 | METHYLENOMYCIN A RESISTANCE PROTEIN |
| 163 | 164 | F RXA01922 | GR00552 | 3 | 1109 | METHYLENOMYCIN A RESISTANCE PROTEIN |
| 165 | 166 | RXA02060 | GR00626 | 1 | 339 | MYCINAMICIN-RESISTANCE PROTEIN MYRA |
| 167 | 168 | RXN01936 | VV0127 | 40116 | 41387 | MACROLIDE-EFFLUX PROTEIN |
| 169 | 170 | F RXA01936 | GR00555 | 9796 | 8975 | NICKEL RESISTANCE PROTEIN |
| 171 | 172 | F RXA01937 | GR00555 | 10246 | 9821 | NICKEL RESISTANCE PROTEIN |
| 173 | 174 | RXN01010 | VV0209 | 3776 | 4894 | QUINOLONE RESISTANCE NORA PROTEIN |
| 175 | 176 | F RXA01010 | GR00288 | 774 | 4 | QUINOLONE RESISTANCE NORA PROTEIN |
| 177 | 178 | RXN03142 | VV0136 | 5754 | 4612 | QUINOLONE RESISTANCE NORA PROTEIN |
| 179 | 180 | F RXA01150 | GR00323 | 3807 | 2917 | QUINOLONE RESISTANCE NORA PROTEIN |
| 181 | 182 | RXN02964 | VV0102 | 7931 | 6714 | QUINOLONE RESISTANCE NORA PROTEIN |
| 183 | 184 | F RXA02116 | GR00636 | 911 | 6 | QUINOLONE RESISTANCE NORA PROTEIN |
| 185 | 186 | RXA00858 | GR00233 | 1680 | 2147 | TELLURIUM RESISTANCE PROTEIN TERC |
| 187 | 188 | RXA02305 | GR00663 | 2921 | 2070 | DAUNOMYCIN C-14 HYDROXYLASE |
| 189 | 190 | RXA00084 | GR00013 | 2367 | 1543 | VIBRIOBACTIN UTILIZATION PROTEIN VIUB |
| 191 | 192 | RXA00843 | GR00228 | 3236 | 3580 | ARSENATE REDUCTASE |
| 193 | 194 | RXA01052 | GR00296 | 3398 | 3706 | MERCURIC REDUCTASE (EC 1.16.1.1) |
| 195 | 196 | RXA01053 | GR00296 | 3772 | 4191 | MERCURIC REDUCTASE (EC 1.16.1.1) |
| 197 | 198 | RXA01054 | GR00296 | 4229 | 4717 | MERCURIC REDUCTASE (EC 1.16.1.1) |
| 199 | 200 | RXN03123 | VV0106 | 808 | 1245 | HEAVY METAL TOLERANCE PROTEIN PRECURSOR |
| 201 | 202 | F RXA00993 | GR00282 | 641 | 6 | HEAVY METAL TOLERANCE PROTEIN PRECURSOR |
| 203 | 204 | RXA01051 | GR00296 | 3298 | 2690 | VANZ PROTEIN, teicoplanin resistance protein |
| 205 | 206 | RXN01873 | VV0248 | 2054 | 819 | Hypothetical Drug Resistance Protein |
| 207 | 208 | F RXA01873 | GR00535 | 855 | 1946 | Hypothetical Drug Resistance Protein |
| 209 | 210 | RXN00034 | VV0020 | 16933 | 18381 | MULTIDRUG RESISTANCE PROTEIN B |
| 211 | 212 | F RXA02273 | GR00655 | 8058 | 9002 | Hypothetical Drug Resistance Protein |
| 213 | 214 | RXN03075 | VV0042 | 2491 | 3216 | Hypothetical Drug Transporter |
| 215 | 216 | F RXA02907 | GR10044 | 1395 | 2120 | Hypothetical Drug Transporter |
| 217 | 218 | RXA00479 | GR00119 | 16290 | 14101 | Hypothetical Drug Transporter |
| 219 | 220 | RXN03124 | VV0108 | 4 | 963 | Hypothetical Drug Transporter |
| 221 | 222 | F RXA01180 | GR00336 | 4 | 765 | Hypothetical Drug Transporter |

Table 1 (continued)

| Nucleic Acid SEQ ID NO | Amino Acid SEQ ID NO | Identification Code | Contig. | NT | | Function |
|---------------------------|-------------------------|---------------------|---------|-------|-------|---|
| | | | | Start | Stop | |
| 223 | 224 | RXA02586 | GR00741 | 10296 | 10027 | Hypothetical Drug Transporter |
| 225 | 226 | RXA02587 | GR00741 | 12343 | 10253 | Hypothetical Drug Transporter |
| 227 | 228 | RXN03042 | VW0018 | 2440 | 1835 | Hypothetical Drug Transporter |
| 229 | 230 | F RXA02893 | GR10035 | 1841 | 1236 | Hypothetical Drug Transporter |
| 231 | 232 | RXA01616 | GR00450 | 1684 | 203 | MULTIDRUG EFFLUX PROTEIN QACB |
| 233 | 234 | RXA01666 | GR00463 | 2307 | 3683 | MULTIDRUG RESISTANCE PROTEIN B |
| 235 | 236 | RXA00062 | GR00009 | 13252 | 11855 | MULTIDRUG RESISTANCE PROTEIN B |
| 237 | 238 | RXA00215 | GR00032 | 13834 | 15294 | MULTIDRUG RESISTANCE PROTEIN B |
| 239 | 240 | RXN03064 | VW0038 | 4892 | 6223 | MULTIDRUG RESISTANCE PROTEIN B |
| 241 | 242 | F RXA00565 | GR00151 | 4892 | 5884 | MULTIDRUG RESISTANCE PROTEIN B |
| 243 | 244 | F RXA02878 | GR10016 | 1837 | 1481 | MULTIDRUG RESISTANCE PROTEIN B |
| 245 | 246 | RXA00648 | GR00169 | 2713 | 1304 | MULTIDRUG RESISTANCE PROTEIN B |
| 247 | 248 | RXN01320 | VW0082 | 13146 | 11500 | MULTIDRUG RESISTANCE PROTEIN B |
| 249 | 250 | F RXA01314 | GR00382 | 744 | 4 | MULTIDRUG RESISTANCE PROTEIN B |
| 251 | 252 | F RXA01320 | GR00383 | 1979 | 1200 | MULTIDRUG RESISTANCE PROTEIN B |
| 253 | 254 | RXN02926 | VW0082 | 11497 | 9866 | MULTIDRUG RESISTANCE PROTEIN B |
| 255 | 256 | F RXA01319 | GR00383 | 1197 | 4 | MULTIDRUG RESISTANCE PROTEIN B |
| 257 | 258 | RXA01578 | GR00439 | 1423 | 29 | MULTIDRUG RESISTANCE PROTEIN B |
| 259 | 260 | RXA02087 | GR00629 | 7076 | 5730 | MULTIDRUG RESISTANCE PROTEIN B |
| 261 | 262 | RXA02088 | GR00629 | 8294 | 7080 | MULTIDRUG RESISTANCE PROTEIN B |
| 263 | 264 | RXA00764 | GR00204 | 3284 | 2169 | MULTIDRUG RESISTANCE PROTEIN B |
| 265 | 266 | RXN03125 | VW0108 | 972 | 1142 | BMRU PROTEIN Bacillus subtilis bmrU, multidrug efflux transporter |
| 267 | 268 | RXN01553 | VW0135 | 25201 | 26520 | Hypothetical Drug Transporter |
| 269 | 270 | RXN00535 | VW0219 | 5155 | 5871 | Hypothetical Drug Permease |
| 271 | 272 | RXN00453 | VW0076 | 1173 | 3521 | Hypothetical Drug Resistance Protein |
| 273 | 274 | RXN00932 | VW0171 | 13120 | 13593 | Hypothetical Drug Transporter |
| 275 | 276 | RXN03022 | VW0002 | 65 | 511 | Hypothetical Drug Transporter |
| 277 | 278 | RXN03151 | VW0163 | 489 | 4 | MULTIDRUG RESISTANCE PROTEIN B |
| 279 | 280 | RXN02832 | VW0358 | 547 | 5 | MYCINAMICIN-RESISTANCE PROTEIN MYRA |
| 281 | 282 | RXN00165 | VW0232 | 3275 | 1860 | LYSOSTAPHIN IMMUNITY FACTOR |
| 283 | 284 | RXN01190 | VW0169 | 8992 | 10338 | MULTIDRUG RESISTANCE-LIKE ATP-BINDING PROTEIN MDL |
| 285 | 286 | RXN01102 | VW0059 | 6128 | 4884 | MULTIDRUG RESISTANCE-LIKE ATP-BINDING PROTEIN MDL |
| 287 | 288 | RXN00788 | VW0321 | 3424 | 3648 | QUINOLONE RESISTANCE NORA PROTEIN |
| 289 | 290 | RXN02119 | VW0102 | 11242 | 9602 | CHLORAMPHENICOL RESISTANCE PROTEIN |
| 291 | 292 | RXN01605 | VW0137 | 7124 | 5610 | A201A-RESISTANCE ATP-BINDING PROTEIN |
| 293 | 294 | RXN01091 | VW0326 | 567 | 4 | DAUNORUBICIN RESISTANCE TRANSMEMBRANE PROTEIN |
| 295 | 296 | RXS02979 | VW0149 | 2150 | 2383 | MAZG PROTEIN |
| 297 | 298 | RXS02987 | VW0234 | 527 | 294 | MERCURIC TRANSPORT PROTEIN PERIPLASMIC COMPONENT PRECURSOR |
| 299 | 300 | RXS03095 | VW0057 | 4056 | 4424 | MERCURIC TRANSPORT PROTEIN PERIPLASMIC COMPONENT PRECURSOR |

TABLE 2 – Excluded Genes

| GenBank™ Accession No. | Gene Name | Gene Function | Reference |
|---|------------------|--|--|
| A09073 | ppg | Phosphoenol pyruvate carboxylase | Bachmann, B. et al. "DNA fragment coding for phosphoenolpyruvate carboxylase, recombinant DNA carrying said fragment, strains carrying the recombinant DNA and method for producing L-aminino acids using said strains," Patent: EP 0358940-A 3 03/21/90 |
| A45579, A45581, A45583, A45585 A45587 | | Threonine dehydratase | Moeckel, B. et al. "Production of L-isoleucine by means of recombinant micro-organisms with deregulated threonine dehydratase," Patent: WO 9519442-A 5 07/20/95 |
| AB003132 | murC; ftsQ; ftsZ | | Kobayashi, M. et al. "Cloning, sequencing, and characterization of the ftsZ gene from coryneform bacteria," <i>Biochem. Biophys. Res. Commun.</i> , 236(2):383-388 (1997) |
| AB015023 | murC; ftsQ | | Wachi, M. et al. "A murC gene from Coryneform bacteria," <i>Appl. Microbiol. Biotechnol.</i> , 51(2):223-228 (1999) |
| AB018530 | ftsR | | Kimura, E. et al. "Molecular cloning of a novel gene, ftsR, which rescues the detergent sensitivity of a mutant derived from <i>Brevibacterium lactofermentum</i> ," <i>Biosci. Biotechnol. Biochem.</i> , 60(10):1565-1570 (1996) |
| AB018531 | ftsR1; ftsR2 | | |
| AB020624 | murI | D-glutamate racemase | |
| AB023377 | tkf | transketolase | |
| AB024708 | gltB; gltD | Glutamine 2-oxoglutarate aminotransferase large and small subunits | |
| AB025424 | acn | aconitase | |
| AB027714 | rep | Replication protein | |
| AB027715 | rep; aad | Replication protein; aminoglycoside adenyltransferase | |
| AF005242 | argC | N-acetylglutamate-5-semialdehyde dehydrogenase | |
| AF005635 | glnA | Glutamine synthetase | |
| AF030405 | hisF | cyclase | |
| AF030520 | argG | Argininosuccinate synthetase | |
| AF031518 | argF | Ornithine carbamoyltransferase | |
| AF036932 | aroD | 3-dehydroquinate dehydratase | |
| AF038548 | pyc | Pyruvate carboxylase | |

Table 2 (continued)

| | dcIAE; apt; rel | Dipeptide-binding protein; adenine phosphoribosyltransferase; GTP pyrophosphokinase | Wehmeier, L. et al. "The role of the Corynebacterium glutamicum rel gene in (p)ppGpp metabolism," <i>Microbiology</i> , 144:1853-1862 (1998) |
|----------|--|---|--|
| AF038651 | | | |
| AF041436 | argR | Arginine repressor | |
| AF045998 | impA | Inositol monophosphate phosphatase | |
| AF048764 | argH | Argininosuccinate lyase | |
| AF049897 | argC; argJ; argB; argD; argF; argR; argG; argH | N-acetylglutamylphosphate reductase; ornithine acetyltransferase; N-acetylglutamate kinase; acetylornithine transaminase; ornithine carbamoyltransferase; arginine repressor; argininosuccinate synthase; argininosuccinate lyase | |
| AF050109 | inhA | Enoyl-acyl carrier protein reductase | |
| AF050166 | hisG | ATP phosphoribosyltransferase | |
| AF051846 | hisA | Phosphoribosylformimino-5-amino-1-phosphoribosyl-4-imidazolecarboxamide isomerase | |
| AF052652 | metA | Homoserine O-acetyltransferase | Park, S. et al. "Isolation and analysis of metA, a methionine biosynthetic gene encoding homoserine acetyltransferase in Corynebacterium glutamicum," <i>Mol. Cells</i> , 8(3):286-294 (1998) |
| AF053071 | aroB | Dehydroquinase synthetase | |
| AF060558 | hisH | Glutamine amidotransferase | |
| AF086704 | hisE | Phosphoribosyl-ATP-pyrophosphohydrolase | |
| AF114233 | aroA | 5-enolpyruvylshikimate 3-phosphate synthase | |
| AF116184 | panD | L-aspartate-alpha-decarboxylase precursor | Dusch, N. et al. "Expression of the Corynebacterium glutamicum panD gene encoding L-aspartate-alpha-decarboxylase leads to pantothenate overproduction in Escherichia coli," <i>Appl. Environ. Microbiol.</i> , 65(4):1530-1539 (1999) |
| AF124518 | aroD; aroE | 3-dehydroquinase; shikimate dehydrogenase | |
| AF124600 | aroC; aroK; aroB; pepQ | Chorismate synthase; shikimate kinase; 3-dehydroquinase synthase; putative cytoplasmic peptidase | |
| AF145897 | inhA | | |
| AF145898 | inhA | | |

Table 2 (continued)

| | | | |
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| AJ001436 | ectP | Transport of ectoine, glycine betaine, proline | Peter, H. et al. "Corynebacterium glutamicum is equipped with four secondary carriers for compatible solutes: Identification, sequencing, and characterization of the proline/ectoine uptake system, ProP, and the ectoine/proline/glycine betaine carrier, EctP," <i>J. Bacteriol.</i> , 180(22):6005-6012 (1998) |
| AJ004934 | dapD | Tetrahydrodipicolinate succinylase (incomplete) | Wehrmann, A. et al. "Different modes of diaminopimelate synthesis and their role in cell wall integrity: A study with <i>Corynebacterium glutamicum</i> ," <i>J. Bacteriol.</i> , 180(12):3159-3165 (1998) |
| AJ007732 | ppc; secG; amt; ocd; soxA | Phosphoenolpyruvate-carboxylase; ?; high affinity ammonium uptake protein; putative ornithine-cyclodecarboxylase; sarcosine oxidase | |
| AJ010319 | ftsY, glnB, glnD; srp; amtP | Involved in cell division; PII protein; uridylyltransferase (uridylyl-removing enzyme); signal recognition particle; low affinity ammonium uptake protein | Jakoby, M. et al. "Nitrogen regulation in <i>Corynebacterium glutamicum</i> ; Isolation of genes involved in biochemical characterization of corresponding proteins," <i>FEMS Microbiol.</i> , 173(2):303-310 (1999) |
| AJ132968 | cat | Chloramphenicol acetyl transferase | |
| AJ224946 | mgo | L-malate: quinone oxidoreductase | Molenaar, D. et al. "Biochemical and genetic characterization of the membrane-associated malate dehydrogenase (acceptor) from <i>Corynebacterium glutamicum</i> ," <i>Eur. J. Biochem.</i> , 254(2):395-403 (1998) |
| AJ238250 | ndh | NADH dehydrogenase | |
| AJ238703 | porA | Porin | Lichtinger, T. et al. "Biochemical and biophysical characterization of the cell wall porin of <i>Corynebacterium glutamicum</i> : The channel is formed by a low molecular mass polypeptide," <i>Biochemistry</i> , 37(43):15024-15032 (1998) |
| D17429 | | Transposable element IS31831 | Vertes et al. "Isolation and characterization of IS31831, a transposable element from <i>Corynebacterium glutamicum</i> ," <i>Mol. Microbiol.</i> , 11(4):739-746 (1994) |
| D84102 | odhA | 2-oxoglutarate dehydrogenase | Usuda, Y. et al. "Molecular cloning of the <i>Corynebacterium glutamicum</i> (Brevibacterium lactofermentum AJ12036) odhA gene encoding a novel type of 2-oxoglutarate dehydrogenase," <i>Microbiology</i> , 142:3347-3354 (1996) |
| E01358 | hdh; hk | Homoserine dehydrogenase; homoserine kinase | Katsumata, R. et al. "Production of L-threonine and L-isoleucine," Patent: JP 1987232392-A 1 10/12/87 |
| E01359 | | Upstream of the start codon of homoserine kinase gene | Katsumata, R. et al. "Production of L-threonine and L-isoleucine," Patent: JP 1987232392-A 2 10/12/87 |
| E01375 | | Tryptophan operon | |
| E01376 | trpL; trpE | Leader peptide; anthranilate synthase | Matsui, K. et al. "Tryptophan operon, peptide and protein coded thereby, utilization of tryptophan operon gene expression and production of tryptophan," Patent: JP 1987244382-A 1 10/24/87 |
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Table 2 (continued)

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| E01377 | Promoter and operator regions of tryptophan operon | Matsui, K. et al. "Tryptophan operon, peptide and protein coded thereby, utilization of tryptophan operon gene expression and production of tryptophan," Patent: JP 1987244382-A 1 10/24/87 |
| E03937 | Biotin-synthase | Hatakeyama, K. et al. "DNA fragment containing gene capable of coding biotin synthetase and its utilization," Patent: JP 1992278088-A 1 10/02/92 |
| E04040 | Diamino pelargonic acid aminotransferase | Kohama, K. et al. "Gene coding diaminopelargonic acid aminotransferase and desthiobiotin synthetase and its utilization," Patent: JP 1992330284-A 1 11/18/92 |
| E04041 | Desthiobiotinsynthetase | Kohama, K. et al. "Gene coding diaminopelargonic acid aminotransferase and desthiobiotin synthetase and its utilization," Patent: JP 1992330284-A 1 11/18/92 |
| E04307 | Flavum aspartase | Kurusu, Y. et al. "Gene DNA coding aspartase and utilization thereof," Patent: JP 1993030977-A 1 02/09/93 |
| E04376 | Isocitric acid lyase | Katsumata, R. et al. "Gene manifestation controlling DNA," Patent: JP 1993056782-A 3 03/09/93 |
| E04377 | Isocitric acid lyase N-terminal fragment | Katsumata, R. et al. "Gene manifestation controlling DNA," Patent: JP 1993056782-A 3 03/09/93 |
| E04484 | Prephenate dehydratase | Sotouchi, N. et al. "Production of L-phenylalanine by fermentation," Patent: JP 1993076352-A 2 03/30/93 |
| E05108 | Aspartokinase | Fugono, N. et al. "Gene DNA coding Aspartokinase and its use," Patent: JP 1993184366-A 1 07/27/93 |
| E05112 | Dihydro-dipichorinate synthetase | Hatakeyama, K. et al. "Gene DNA coding dihydrodipicolinic acid synthetase and its use," Patent: JP 1993184371-A 1 07/27/93 |
| E05776 | Diaminopimelic acid dehydrogenase | Kobayashi, M. et al. "Gene DNA coding Diaminopimelic acid dehydrogenase and its use," Patent: JP 1993284970-A 1 11/02/93 |
| E05779 | Threonine synthase | Kohama, K. et al. "Gene DNA coding threonine synthase and its use," Patent: JP 1993284972-A 1 11/02/93 |
| E06110 | Prephenate dehydratase | Kikuchi, T. et al. "Production of L-phenylalanine by fermentation method," Patent: JP 1993344881-A 1 12/27/93 |
| E06111 | Mutated Prephenate dehydratase | Kikuchi, T. et al. "Production of L-phenylalanine by fermentation method," Patent: JP 1993344881-A 1 12/27/93 |
| E06146 | Acetohydroxy acid synthetase | Inui, M. et al. "Gene capable of coding Acetohydroxy acid synthetase and its use," Patent: JP 1993344893-A 1 12/27/93 |
| E06825 | Aspartokinase | Sugimoto, M. et al. "Mutant aspartokinase gene," patent: JP 1994062866-A 1 03/08/94 |
| E06826 | Mutated aspartokinase alpha subunit | Sugimoto, M. et al. "Mutant aspartokinase gene," patent: JP 1994062866-A 1 03/08/94 |

Table 2 (continued)

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|--|------|--|---|
| E06827 | | Mutated aspartokinase alpha subunit | Sugimoto, M. et al. "Mutant aspartokinase gene," patent: JP 1994062866-A 1 03/08/94 |
| E07701 | secY | | Honno, N. et al. "Gene DNA participating in integration of membraneous protein to membrane," Patent: JP 1994169780-A 1 06/21/94 |
| E08177 | | Aspartokinase | Sato, Y. et al. "Genetic DNA capable of coding Aspartokinase released from feedback inhibition and its utilization," Patent: JP 1994261766-A 1 09/20/94 |
| E08178, E08179, E08180, E08181, E08182 | | Feedback inhibition-released Aspartokinase | Sato, Y. et al. "Genetic DNA capable of coding Aspartokinase released from feedback inhibition and its utilization," Patent: JP 1994261766-A 1 09/20/94 |
| E08232 | | Acetohydroxy-acid isomeroreductase | Inui, M. et al. "Gene DNA coding acetohydroxy acid isomeroreductase," Patent: JP 1994277067-A 1 10/04/94 |
| E08234 | secE | | Asai, Y. et al. "Gene DNA coding for translocation machinery of protein," Patent: JP 1994277073-A 1 10/04/94 |
| E08643 | | FT aminotransferase and desthiobiotin synthetase promoter region | Hatakeyama, K. et al. "DNA fragment having promoter function in coryneform bacterium," Patent: JP 1995031476-A 1 02/03/95 |
| E08646 | | Biotin synthetase | Hatakeyama, K. et al. "DNA fragment having promoter function in coryneform bacterium," Patent: JP 1995031476-A 1 02/03/95 |
| E08649 | | Aspartase | Kohama, K. et al. "DNA fragment having promoter function in coryneform bacterium," Patent: JP 1995031478-A 1 02/03/95 |
| E08900 | | Dihydrodipicolinate reductase | Madori, M. et al. "DNA fragment containing gene coding Dihydrodipicolinate acid reductase and utilization thereof," Patent: JP 1995075578-A 1 03/20/95 |
| E08901 | | Diaminopimelic acid decarboxylase | Madori, M. et al. "DNA fragment containing gene coding Diaminopimelic acid decarboxylase and utilization thereof," Patent: JP 1995075579-A 1 03/20/95 |
| E12594 | | Serine hydroxymethyltransferase | Hatakeyama, K. et al. "Production of L-tryptophan," Patent: JP 1997028391-A 1 02/04/97 |
| E12760, E12759, E12758 | | transposase | Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97 |
| E12764 | | Arginyl-tRNA synthetase; diaminopimelic acid decarboxylase | Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97 |
| E12767 | | Dihydrodipicolinic acid synthetase | Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97 |
| E12770 | | aspartokinase | Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97 |
| E12773 | | Dihydrodipicolinic acid reductase | Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97 |

Table 2 (continued)

| | | | |
|--------|------------------|--|---|
| E13655 | | Glucose-6-phosphate dehydrogenase | Hatakeyama, K. et al. "Glucose-6-phosphate dehydrogenase and DNA capable of coding the same," Patent: JP 1997224661-A 1 09/02/97 |
| L01508 | ilvA | Threonine dehydratase | Moeckel, B. et al. "Functional and structural analysis of the threonine dehydratase of Corynebacterium glutamicum," <i>J. Bacteriol.</i> , 174:8065-8072 (1992) |
| L07603 | EC 4.2.1.15 | 3-deoxy-D-arabinoheptulosonate-7-phosphate synthase | Chen, C. et al. "The cloning and nucleotide sequence of Corynebacterium glutamicum 3-deoxy-D-arabinoheptulosonate-7-phosphate synthase gene," <i>FEMS Microbiol. Lett.</i> , 107:223-230 (1993) |
| L09232 | ilvB; ilvN; ilvC | Acetohydroxy acid synthase large subunit; Acetohydroxy acid synthase small subunit; Acetohydroxy acid isomeroreductase | Keilhauer, C. et al. "Isoleucine synthesis in Corynebacterium glutamicum: molecular analysis of the ilvB-ilvN-ilvC operon," <i>J. Bacteriol.</i> , 175(17):5595-5603 (1993) |
| L18874 | PtsM | Phosphoenolpyruvate sugar phosphotransferase | Fouet, A. et al. "Bacillus subtilis sucrose-specific enzyme II of the phosphotransferase system: expression in Escherichia coli and homology to enzymes II from enteric bacteria," <i>PNAS USA</i> , 84(24):8773-8777 (1987); Lee, J.K. et al. "Nucleotide sequence of the gene encoding the Corynebacterium glutamicum mannose enzyme II and analyses of the deduced protein sequence," <i>FEMS Microbiol. Lett.</i> , 119(1-2):137-145 (1994) |
| L27123 | aceB | Malate synthase | Lee, H-S. et al. "Molecular characterization of aceB, a gene encoding malate synthase in Corynebacterium glutamicum," <i>J. Microbiol. Biotechnol.</i> , 4(4):256-263 (1994) |
| L27126 | | Pyruvate kinase | Jetten, M. S. et al. "Structural and functional analysis of pyruvate kinase from Corynebacterium glutamicum," <i>Appl. Environ. Microbiol.</i> , 60(7):2501-2507 (1994) |
| L28760 | aceA | Isocitrate lyase | |
| L35906 | dtxR | Diphtheria toxin repressor | Oguiza, J.A. et al. "Molecular cloning, DNA sequence analysis, and characterization of the Corynebacterium diphtheriae dtxR from Brevibacterium lactofermentum," <i>J. Bacteriol.</i> , 177(2):465-467 (1995) |
| M13774 | | Prephenate dehydratase | Follettie, M.T. et al. "Molecular cloning and nucleotide sequence of the Corynebacterium glutamicum pheA gene," <i>J. Bacteriol.</i> , 167:695-702 (1986) |
| M16175 | 5S rRNA | | Park, Y-H. et al. "Phylogenetic analysis of the coryneform bacteria by 5S rRNA sequences," <i>J. Bacteriol.</i> , 169:1801-1806 (1987) |
| M16663 | trpE | Anthranilate synthase, 5' end | Sano, K. et al. "Structure and function of the trp operon control regions of Brevibacterium lactofermentum, a glutamic-acid-producing bacterium," <i>Gene</i> , 52:191-200 (1987) |
| M16664 | trpA | Tryptophan synthase, 3' end | Sano, K. et al. "Structure and function of the trp operon control regions of Brevibacterium lactofermentum, a glutamic-acid-producing bacterium," <i>Gene</i> , 52:191-200 (1987) |

Table 2 (continued)

| | | | |
|-------------------|------------------------|--|--|
| M25819 | | Phosphoenolpyruvate carboxylase | O'Regan, M. et al. "Cloning and nucleotide sequence of the Phosphoenolpyruvate carboxylase-coding gene of <i>Corynebacterium glutamicum</i> ATCC13032," <i>Gene</i> , 77(2):237-251 (1989) |
| M85106 | | 23S rRNA gene insertion sequence | Roller, C. et al. "Gram-positive bacteria with a high DNA G+C content are characterized by a common insertion within their 23S rRNA genes," <i>J. Gen. Microbiol.</i> , 138:1167-1175 (1992) |
| M85107, M85108 | | 23S rRNA gene insertion sequence | Roller, C. et al. "Gram-positive bacteria with a high DNA G+C content are characterized by a common insertion within their 23S rRNA genes," <i>J. Gen. Microbiol.</i> , 138:1167-1175 (1992) |
| M89931 | aecD; brnQ; yhbW | Beta C-S lyase; branched-chain amino acid uptake carrier; hypothetical protein yhbW | Rossol, I. et al. "The <i>Corynebacterium glutamicum</i> aecD gene encodes a C-S lyase with alpha, beta-elimination activity that degrades aminoethylcysteine," <i>J. Bacteriol.</i> , 174(9):2968-2977 (1992); Tauch, A. et al. "Isoleucine uptake in <i>Corynebacterium glutamicum</i> ATCC 13032 is directed by the brnQ gene product," <i>Arch. Microbiol.</i> , 169(4):303-312 (1998) |
| S59299 | trp | Leader gene (promoter) | Herry, D.M. et al. "Cloning of the trp gene cluster from a tryptophan-hyperproducing strain of <i>Corynebacterium glutamicum</i> : identification of a mutation in the trp leader sequence," <i>Appl. Environ. Microbiol.</i> , 59(3):791-799 (1993) |
| U11545 | trpD | Anthranilate phosphoribosyltransferase | O'Gara, J.P. and Dunican, L.K. (1994) Complete nucleotide sequence of the <i>Corynebacterium glutamicum</i> ATCC 21850 trpD gene." Thesis, Microbiology Department, University College Galway, Ireland. |
| U13922 | cgIIIM; cgIIIR; cglIIR | Putative type II 5-cytosine methyltransferase; putative type II restriction endonuclease; putative type I or type III restriction endonuclease | Schafer, A. et al. "Cloning and characterization of a DNA region encoding a stress-sensitive restriction system from <i>Corynebacterium glutamicum</i> ATCC 13032 and analysis of its role in intergeneric conjugation with <i>Escherichia coli</i> ," <i>J. Bacteriol.</i> , 176(23):7309-7319 (1994); Schafer, A. et al. "The <i>Corynebacterium glutamicum</i> cglIM gene encoding a 5-cytosine in an McrBC-deficient <i>Escherichia coli</i> strain," <i>Gene</i> , 203(2):95-101 (1997) |
| U14965 | recA | | |
| U31224 | ppx | | Ankri, S. et al. "Mutations in the <i>Corynebacterium glutamicum</i> proline biosynthetic pathway: A natural bypass of the proA step," <i>J. Bacteriol.</i> , 178(15):4412-4419 (1996) |
| U31225 | proC | L-proline: NADP+ 5-oxidoreductase | Ankri, S. et al. "Mutations in the <i>Corynebacterium glutamicum</i> proline biosynthetic pathway: A natural bypass of the proA step," <i>J. Bacteriol.</i> , 178(15):4412-4419 (1996) |
| U31230 | obg; proB; unkdh | ?; gamma glutamyl kinase; similar to D-isomer specific 2-hydroxyacid dehydrogenases | Ankri, S. et al. "Mutations in the <i>Corynebacterium glutamicum</i> proline biosynthetic pathway: A natural bypass of the proA step," <i>J. Bacteriol.</i> , 178(15):4412-4419 (1996) |

Table 2 (continued)

| | | | |
|--------|--|--|---|
| U31281 | bioB | Biotin synthase | Serebriiskii, I.G., "Two new members of the bio B superfamily: Cloning, sequencing and expression of bio B genes of <i>Methylobacillus flagellatum</i> and <i>Corynebacterium glutamicum</i> ," <i>Gene</i> , 175:15-22 (1996) |
| U35023 | thtR; accBC | Thiosulfate sulfurtransferase; acyl CoA carboxylase | Jager, W. et al. "A <i>Corynebacterium glutamicum</i> gene encoding a two-domain protein similar to biotin carboxylases and biotin-carboxyl-carrier proteins," <i>Arch. Microbiol.</i> , 166(2):76-82 (1996) |
| U43535 | cmr | Multidrug resistance protein | Jager, W. et al. "A <i>Corynebacterium glutamicum</i> gene conferring multidrug resistance in the heterologous host <i>Escherichia coli</i> ," <i>J. Bacteriol.</i> , 179(7):2449-2451 (1997) |
| U43536 | clpB | Heat shock ATP-binding protein | |
| U53587 | aphA-3 | 3'-5'-aminoglycoside phosphotransferase | |
| U89648 | | <i>Corynebacterium glutamicum</i> unidentified sequence involved in histidine biosynthesis, partial sequence | |
| X04960 | trpA; trpB; trpC; trpD; trpE; trpG; trpL | Tryptophan operon | Matsui, K. et al. "Complete nucleotide and deduced amino acid sequences of the <i>Brevibacterium lactofermentum</i> tryptophan operon," <i>Nucleic Acids Res.</i> , 14(24):10113-10114 (1986) |
| X07563 | lys A | DAP decarboxylase (meso-diaminopimelate decarboxylase, EC 4.1.1.20) | Yeh, P. et al. "Nucleic sequence of the <i>lysA</i> gene of <i>Corynebacterium glutamicum</i> and possible mechanisms for modulation of its expression," <i>Mol. Gen. Genet.</i> , 212(1):112-119 (1988) |
| X14234 | EC 4.1.1.31 | Phosphoenolpyruvate carboxylase | Eikmanns, B.J. et al. "The Phosphoenolpyruvate carboxylase gene of <i>Corynebacterium glutamicum</i> : Molecular cloning, nucleotide sequence, and expression," <i>Mol. Gen. Genet.</i> , 218(2):330-339 (1989); Lepiniec, L. et al. "Sorghum Phosphoenolpyruvate carboxylase gene family: structure, function and molecular evolution," <i>Plant. Mol. Biol.</i> , 21 (3):487-502 (1993) |
| X17313 | fda | Fructose-bisphosphate aldolase | Von der Osten, C.H. et al. "Molecular cloning, nucleotide sequence and fine-structural analysis of the <i>Corynebacterium glutamicum</i> <i>fda</i> gene: structural comparison of <i>C. glutamicum</i> fructose-1, 6-bisphosphate aldolase to class I and class II aldolases," <i>Mol. Microbiol.</i> , |
| X53993 | dapA | L-2, 3-dihydrodipicolinate synthetase (EC 4.2.1.52) | Bonnassie, S. et al. "Nucleic sequence of the <i>dapA</i> gene from <i>Corynebacterium glutamicum</i> ," <i>Nucleic Acids Res.</i> , 18(21):6421 (1990) |
| X54223 | | AttB-related site | Cianciotto, N. et al. "DNA sequence homology between att B-related sites of <i>Corynebacterium diphtheriae</i> , <i>Corynebacterium ulcerans</i> , <i>Corynebacterium glutamicum</i> , and the attP site of <i>lambdacorynephage</i> ," <i>FEMS. Microbiol. Lett.</i> , 66:299-302 (1990) |
| X54740 | argS; lysA | Arginyl-tRNA synthetase; Diaminopimelate decarboxylase | Marcel, T. et al. "Nucleotide sequence and organization of the upstream region of the <i>Corynebacterium glutamicum</i> <i>lysA</i> gene," <i>Mol. Microbiol.</i> , 4(11):1819-1830 (1990) |

Table 2 (continued)

| | | | |
|--------|----------------------------|--|---|
| X55994 | trpL; trpE | Putative leader peptide; anthranilate synthase component 1 | Heery, D.M. et al. "Nucleotide sequence of the Corynebacterium glutamicum trpE gene," <i>Nucleic Acids Res.</i> , 18(23):7138 (1990) |
| X56037 | thrC | Threonine synthase | Han, K.S. et al. "The molecular structure of the Corynebacterium glutamicum threonine synthase gene," <i>Mol. Microbiol.</i> , 4(10):1693-1702 (1990) |
| X56075 | attB-related site | Attachment site | Cianciotto, N. et al. "DNA sequence homology between att B-related sites of Corynebacterium diphtheriae, Corynebacterium ulcerans, Corynebacterium glutamicum, and the attP site of lambda dacryonephage," <i>FEMS. Microbiol. Lett.</i> , 66:299-302 (1990) |
| X57226 | lysC-alpha; lysC-beta; asd | Aspartokinase-alpha subunit; Aspartokinase-beta subunit; aspartate beta semialdehyde dehydrogenase | Kalinowski, J. et al. "Genetic and biochemical analysis of the Aspartokinase from Corynebacterium glutamicum," <i>Mol. Microbiol.</i> , 5(5):1197-1204 (1991); Kalinowski, J. et al. "Aspartokinase genes lysC alpha and lysC beta overlap and are adjacent to the aspartate beta-semialdehyde dehydrogenase gene asd in Corynebacterium glutamicum," <i>Mol. Gen. Genet.</i> , 224(3):317-324 (1990) |
| X59403 | gap;pgk; tpi | Glyceraldehyde-3-phosphate; phosphoglycerate kinase; triosephosphate isomerase | Eikmanns, B.J. "Identification, sequence analysis, and expression of a Corynebacterium glutamicum gene cluster encoding the three glycolytic enzymes glyceraldehyde-3-phosphate dehydrogenase, 3-phosphoglycerate kinase, and triosephosphate isomerase," <i>J. Bacteriol.</i> , 174(19):6076-6086 (1992) |
| X59404 | gdh | Glutamate dehydrogenase | Bormann, E.R. et al. "Molecular analysis of the Corynebacterium glutamicum gdh gene encoding glutamate dehydrogenase," <i>Mol. Microbiol.</i> , 6(3):317-326 (1992) |
| X60312 | lysI | L-lysine permease | Seep-Feldhaus, A.H. et al. "Molecular analysis of the Corynebacterium glutamicum lysI gene involved in lysine uptake," <i>Mol. Microbiol.</i> , 5(12):2995-3005 (1991) |
| X66078 | copI | Psl protein | Jolliff, G. et al. "Cloning and nucleotide sequence of the cspI gene encoding Psl, one of the two major secreted proteins of Corynebacterium glutamicum: The deduced N-terminal region of Psl is similar to the Mycobacterium antigen 85 complex," <i>Mol. Microbiol.</i> , 6(16):2349-2362 (1992) |
| X66112 | glt | Citrate synthase | Eikmanns, B.J. et al. "Cloning sequence, expression and transcriptional analysis of the Corynebacterium glutamicum gltA gene encoding citrate synthase," <i>Microbiol.</i> , 140:1817-1828 (1994) |
| X67737 | dapB | Dihydrodipicolinate reductase | |
| X69103 | csp2 | Surface layer protein PS2 | Peyret, J.L. et al. "Characterization of the cspB gene encoding PS2, an ordered surface-layer protein in Corynebacterium glutamicum," <i>Mol. Microbiol.</i> , 9(1):97-109 (1993) |
| X69104 | | IS3 related insertion element | Bonamy, C. et al. "Identification of IS1206, a Corynebacterium glutamicum IS3-related insertion sequence and phylogenetic analysis," <i>Mol. Microbiol.</i> , 14(3):571-581 (1994) |

Table 2 (continued)

| | | | |
|-------------------|---------------------------|---------------------------------------|--|
| X70959 | leuA | Isopropylmalate synthase | Patek, M. et al. "Leucine synthesis in <i>Corynebacterium glutamicum</i> : enzyme activities, structure of leuA, and effect of leuA inactivation on lysine synthesis," <i>Appl. Environ. Microbiol.</i> , 60(1):133-140 (1994) |
| X71489 | icd | Isocitrate dehydrogenase (NADP+) | Eikmanns, B.J. et al. "Cloning sequence analysis, expression, and inactivation of the <i>Corynebacterium glutamicum</i> icd gene encoding isocitrate dehydrogenase and biochemical characterization of the enzyme," <i>J. Bacteriol.</i> , 177(3):774-782 (1995) |
| X72855 | GDHA | Glutamate dehydrogenase (NADP+) | |
| X75083, X70584 | mtrA | 5-methyltryptophan resistance | Heery, D.M. et al. "A sequence from a tryptophan-hyperproducing strain of <i>Corynebacterium glutamicum</i> encoding resistance to 5-methyltryptophan," <i>Biochem. Biophys. Res. Commun.</i> , 201(3):1255-1262 (1994) |
| X75085 | recA | | Fitzpatrick, R. et al. "Construction and characterization of recA mutant strains of <i>Corynebacterium glutamicum</i> and <i>Brevibacterium lactofermentum</i> ," <i>Appl. Microbiol. Biotechnol.</i> , 42(4):575-580 (1994) |
| X75504 | aceA; thiX | Partial Isocitrate lyase; ? | Reinscheid, D.J. et al. "Characterization of the isocitrate lyase gene from <i>Corynebacterium glutamicum</i> and biochemical analysis of the enzyme," <i>J. Bacteriol.</i> , 176(12):3474-3483 (1994) |
| X76875 | | ATPase beta-subunit | Ludwig, W. et al. "Phylogenetic relationships of bacteria based on comparative sequence analysis of elongation factor Tu and ATP-synthase beta-subunit genes," <i>Antonie Van Leeuwenhoek</i> , 64:285-305 (1993) |
| X77034 | tuf | Elongation factor Tu | Ludwig, W. et al. "Phylogenetic relationships of bacteria based on comparative sequence analysis of elongation factor Tu and ATP-synthase beta-subunit genes," <i>Antonie Van Leeuwenhoek</i> , 64:285-305 (1993) |
| X77384 | recA | | Billman-Jacobe, H. "Nucleotide sequence of a recA gene from <i>Corynebacterium glutamicum</i> ," <i>DNA Seq.</i> , 4(6):403-404 (1994) |
| X78491 | aceB | Malate synthase | Reinscheid, D.J. et al. "Malate synthase from <i>Corynebacterium glutamicum</i> pta-ack operon encoding phosphotransacetylase: sequence analysis," <i>Microbiology</i> , 140:3099-3108 (1994) |
| X80629 | 16S rDNA | 16S ribosomal RNA | Rainey, F.A. et al. "Phylogenetic analysis of the genera <i>Rhodococcus</i> and <i>Norcardia</i> and evidence for the evolutionary origin of the genus <i>Norcardia</i> from within the radiation of <i>Rhodococcus</i> species," <i>Microbiol.</i> , 141:523-528 (1995) |
| X81191 | gluA; gluB; gluC; gluD | Glutamate uptake system | Kronmeyer, W. et al. "Structure of the gluABCD cluster encoding the glutamate uptake system of <i>Corynebacterium glutamicum</i> ," <i>J. Bacteriol.</i> , 177(5):1152-1158 (1995) |
| X81379 | dapE | Succinyldiaminopimelate desuccinylase | Wehrmann, A. et al. "Analysis of different DNA fragments of <i>Corynebacterium glutamicum</i> complementing dapE of <i>Escherichia coli</i> ," <i>Microbiology</i> , 40:3349-56 (1994) |

Table 2 (continued)

| | 16S rDNA | 16S ribosomal RNA | |
|--------|------------------------------|--|---|
| X82061 | | | Ruimy, R. et al. "Phylogeny of the genus <i>Corynebacterium</i> deduced from analyses of small-subunit ribosomal DNA sequences," <i>Int. J. Syst. Bacteriol.</i> , 45(4):740-746 (1995) |
| X82928 | asd; lysC | Aspartate-semialdehyde dehydrogenase; ? | Serebrijski, I. et al. "Multicopy suppression by asd gene and osmotic stress-dependent complementation by heterologous proA in proA mutants," <i>J. Bacteriol.</i> , 177(24):7255-7260 (1995) |
| X82929 | proA | Gamma-glutamyl phosphate reductase | Serebrijski, I. et al. "Multicopy suppression by asd gene and osmotic stress-dependent complementation by heterologous proA in proA mutants," <i>J. Bacteriol.</i> , 177(24):7255-7260 (1995) |
| X84257 | 16S rDNA | 16S ribosomal RNA | Pascual, C. et al. "Phylogenetic analysis of the genus <i>Corynebacterium</i> based on 16S rRNA gene sequences," <i>Int. J. Syst. Bacteriol.</i> , 45(4):724-728 (1995) |
| X85965 | aroP; dapE | Aromatic amino acid permease; ? | Wehrmann et al. "Functional analysis of sequences adjacent to dapE of <i>C. glutamicum</i> proline reveals the presence of aroP, which encodes the aromatic amino acid transporter," <i>J. Bacteriol.</i> , 177(20):5991-5993 (1995) |
| X86157 | argB; argC; argD; argF; argJ | Acetylglutamate kinase; N-acetyl-gamma-glutamyl-phosphate reductase; acetylornithine aminotransferase; ornithine carbamoyltransferase; glutamate N-acetyltransferase | Sakanyan, V. et al. "Genes and enzymes of the acetyl cycle of arginine biosynthesis in <i>Corynebacterium glutamicum</i> : enzyme evolution in the early steps of the arginine pathway," <i>Microbiology</i> , 142:99-108 (1996) |
| X89084 | pta; ackA | Phosphate acetyltransferase; acetate kinase | Reinscheid, D.J. et al. "Cloning, sequence analysis, expression and inactivation of the <i>Corynebacterium glutamicum</i> pta-ack operon encoding phosphotransacetylase and acetate kinase," <i>Microbiology</i> , 145:503-513 (1999) |
| X89850 | attB | Attachment site | Le Marrec, C. et al. "Genetic characterization of site-specific integration functions of phi AAU2 infecting 'Arthrobacter aureus C70,'" <i>J. Bacteriol.</i> , 178(7):1996-2004 (1996) |
| X90356 | | Promoter fragment F1 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90357 | | Promoter fragment F2 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90358 | | Promoter fragment F10 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90359 | | Promoter fragment F13 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| | | | |

Table 2 (continued)

| | | |
|--------|--|---|
| X90360 | Promoter fragment F22 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90361 | Promoter fragment F34 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90362 | Promoter fragment F37 | Patek, M. et al. "Promoters from <i>C. glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90363 | Promoter fragment F45 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90364 | Promoter fragment F64 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90365 | Promoter fragment F75 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90366 | Promoter fragment PF101 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90367 | Promoter fragment PF104 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X90368 | Promoter fragment PF109 | Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996) |
| X93513 | Ammonium transport system | Siewe, R.M. et al. "Functional and genetic characterization of the (methyl) ammonium uptake carrier of <i>Corynebacterium glutamicum</i> ," <i>J. Biol. Chem.</i> , 271(10):5398-5403 (1996) |
| X93514 | Glycine betaine transport system | Peter, H. et al. "Isolation, characterization, and expression of the <i>Corynebacterium glutamicum</i> betP gene, encoding the transport system for the compatible solute glycine betaine," <i>J. Bacteriol.</i> , 178(17):5229-5234 (1996) |
| X95649 | orf4 | Patek, M. et al. "Identification and transcriptional analysis of the dapB-ORF2-dapA-ORF4 operon of <i>Corynebacterium glutamicum</i> , encoding two enzymes involved in L-lysine synthesis," <i>Biotechnol. Lett.</i> , 19:1113-1117 (1997) |
| X96471 | Lysine exporter protein; Lysine export regulator protein | Vrljic, M. et al. "A new type of transporter with a new type of cellular function: L-lysine export from <i>Corynebacterium glutamicum</i> ," <i>Mol. Microbiol.</i> , 22(5):815-826 (1996) |

Table 2 (continued)

| | | | |
|--------|-----------------------|--|--|
| X96580 | panB; panC; xylB | 3-methyl-2-oxobutanoate hydroxymethyltransferase; pantoate-beta-alanine ligase; xylulokinase | Sahm, H. et al. "D-pantothenate synthesis in Corynebacterium glutamicum and use of panBC and genes encoding L-valine synthesis for D-pantothenate overproduction," <i>Appl. Environ. Microbiol.</i> , 65(5):1973-1979 (1999) |
| X96962 | | Insertion sequence IS1207 and transposase | |
| X99289 | | Elongation factor P | Ramos, A. et al. "Cloning, sequencing and expression of the gene encoding elongation factor P in the amino-acid producer Brevibacterium lactofermentum (Corynebacterium glutamicum ATCC 13869)," <i>Gene</i> , 198:217-222 (1997) |
| Y00140 | thrB | Homoserine kinase | Mateos, L.M. et al. "Nucleotide sequence of the homoserine kinase (thrB) gene of the Brevibacterium lactofermentum," <i>Nucleic Acids Res.</i> , 15(9):3922 (1987) |
| Y00151 | ddh | Meso-diaminopimelate D-dehydrogenase (EC 1.4.1.16) | Ishino, S. et al. "Nucleotide sequence of the meso-diaminopimelate D-dehydrogenase gene from Corynebacterium glutamicum," <i>Nucleic Acids Res.</i> , 15(9):3917 (1987) |
| Y00476 | thrA | Homoserine dehydrogenase | Mateos, L.M. et al. "Nucleotide sequence of the homoserine dehydrogenase (thrA) gene of the Brevibacterium lactofermentum," <i>Nucleic Acids Res.</i> , 15(24):10598 (1987) |
| Y00546 | hom; thrB | Homoserine dehydrogenase; homoserine kinase | Peoples, O.P. et al. "Nucleotide sequence and fine structural analysis of the Corynebacterium glutamicum hom-thrB operon," <i>Mol. Microbiol.</i> , 2(1):63-72 (1988) |
| Y08964 | murC; ftsQ/divD; ftsZ | UPD-N-acetylmuramate-alanine ligase; division initiation protein or cell division protein; cell division protein | Honrubia, M.P. et al. "Identification, characterization, and chromosomal organization of the ftsZ gene from Brevibacterium lactofermentum," <i>Mol. Gen. Genet.</i> , 259(1):97-104 (1998) |
| Y09163 | putP | High affinity proline transport system | Peter, H. et al. "Isolation of the putP gene of Corynebacterium glutamicumproline and characterization of a low-affinity uptake system for compatible solutes," <i>Arch. Microbiol.</i> , 168(2):143-151 (1997) |
| Y09548 | pyc | Pyruvate carboxylase | Peters-Wendisch, P.G. et al. "Pyruvate carboxylase from Corynebacterium glutamicum: characterization, expression and inactivation of the pyc gene," <i>Microbiology</i> , 144:915-927 (1998) |
| Y09578 | leuB | 3-isopropylmalate dehydrogenase | Patek, M. et al. "Analysis of the leuB gene from Corynebacterium glutamicum," <i>Appl. Microbiol. Biotechnol.</i> , 50(1):42-47 (1998) |
| Y12472 | | Attachment site bacteriophage Phi-16 | Moreau, S. et al. "Site-specific integration of corynebacteriophage Phi-16: The construction of an integration vector," <i>Microbiol.</i> , 145:539-548 (1999) |
| Y12537 | proP | Proline/ectoine uptake system protein | Peter, H. et al. "Corynebacterium glutamicum is equipped with four secondary carriers for compatible solutes: Identification, sequencing, and characterization of the proline/ectoine uptake system, ProP, and the ectoine/proline/glycine betaine carrier, EctP," <i>J. Bacteriol.</i> , 180(22):6005-6012 (1998) |

Table 2 (continued)

| | | | |
|--|------------|---|--|
| Y13221 | glnA | Glutamine synthetase I | Jakoby, M. et al. "Isolation of <i>Corynebacterium glutamicum</i> glnA gene encoding glutamine synthetase I," <i>FEMS Microbiol. Lett.</i> , 154(1):81-88 (1997) |
| Y16642 | lpd | Dihydrolipoamide dehydrogenase | |
| Y18059 | | Attachment site Corynebacterium 304L | Moreau, S. et al. "Analysis of the integration functions of ϕ 304L: An integrase module among corynebacteriophages," <i>Virology</i> , 255(1):150-159 (1999) |
| Z21501 | argS; lysA | Arginyl-tRNA synthetase; diaminopimelate decarboxylase (partial) | Oguiza, J.A. et al. "A gene encoding arginyl-tRNA synthetase is located in the upstream region of the lysA gene in <i>Brevibacterium lactofermentum</i> : Regulation of argS-lysA cluster expression by arginine," <i>J. Bacteriol.</i> , 175(22):7356-7362 (1993) |
| Z21502 | dapA; dapB | Dihydrodipicolinate synthase; dihydrodipicolinate reductase | Pisabarro, A. et al. "A cluster of three genes (dapA, orf2, and dapB) of <i>Brevibacterium lactofermentum</i> encodes dihydrodipicolinate reductase, and a third polypeptide of unknown function," <i>J. Bacteriol.</i> , 175(9):2743-2749 (1993) |
| Z29563 | thrC | Threonine synthase | Malumbres, M. et al. "Analysis and expression of the thrC gene of the encoded threonine synthase," <i>Appl. Environ. Microbiol.</i> , 60(7):2209-2219 (1994) |
| Z46753 | 16S rDNA | Gene for 16S ribosomal RNA | |
| Z49822 | sigA | SigA sigma factor | Oguiza, J.A. et al. "Multiple sigma factor genes in <i>Brevibacterium lactofermentum</i> : Characterization of sigA and sigB," <i>J. Bacteriol.</i> , 178(2):550-553 (1996) |
| Z49823 | galE; dtxR | Catalytic activity UDP-galactose 4-epimerase; diphtheria toxin regulatory protein | Oguiza, J.A. et al. "The galE gene encoding the UDP-galactose 4-epimerase of <i>Brevibacterium lactofermentum</i> is coupled transcriptionally to the dmdR gene," <i>Gene</i> , 177:103-107 (1996) |
| Z49824 | orf1; sigB | ?; SigB sigma factor | Oguiza, J.A. et al. "Multiple sigma factor genes in <i>Brevibacterium lactofermentum</i> : Characterization of sigA and sigB," <i>J. Bacteriol.</i> , 178(2):550-553 (1996) |
| Z66534 | | Transposase | Correia, A. et al. "Cloning and characterization of an IS-like element present in the genome of <i>Brevibacterium lactofermentum</i> ATCC 13869," <i>Gene</i> , 170(1):91-94 (1996) |
| * A sequence for this gene was published in the indicated reference. However, the sequence obtained by the inventors of the present application is significantly longer than the published version. It is believed that the published version relied on an incorrect start codon, and thus represents only a fragment of the actual coding region. | | | |

TABLE 3: Corynebacterium and Brevibacterium Strains Which May be Used in the Practice of the Invention

| Genus | species | ATCC | FERM | NRRL | CECT | NCIMB | CBS | NCTC | DSMZ |
|----------------|----------------|-------|------|--------|------|-------|-----|------|------|
| Brevibacterium | ammoniagenes | 21054 | | | | | | | |
| Brevibacterium | ammoniagenes | 19350 | | | | | | | |
| Brevibacterium | ammoniagenes | 19351 | | | | | | | |
| Brevibacterium | ammoniagenes | 19352 | | | | | | | |
| Brevibacterium | ammoniagenes | 19353 | | | | | | | |
| Brevibacterium | ammoniagenes | 19354 | | | | | | | |
| Brevibacterium | ammoniagenes | 19355 | | | | | | | |
| Brevibacterium | ammoniagenes | 19356 | | | | | | | |
| Brevibacterium | ammoniagenes | 21055 | | | | | | | |
| Brevibacterium | ammoniagenes | 21077 | | | | | | | |
| Brevibacterium | ammoniagenes | 21553 | | | | | | | |
| Brevibacterium | ammoniagenes | 21580 | | | | | | | |
| Brevibacterium | ammoniagenes | 39101 | | | | | | | |
| Brevibacterium | butanicum | 21196 | | | | | | | |
| Brevibacterium | divaricatum | 21792 | P928 | | | | | | |
| Brevibacterium | flavum | 21474 | | | | | | | |
| Brevibacterium | flavum | 21129 | | | | | | | |
| Brevibacterium | flavum | 21518 | | | | | | | |
| Brevibacterium | flavum | | | B11474 | | | | | |
| Brevibacterium | flavum | | | B11472 | | | | | |
| Brevibacterium | flavum | 21127 | | | | | | | |
| Brevibacterium | flavum | 21128 | | | | | | | |
| Brevibacterium | flavum | 21427 | | | | | | | |
| Brevibacterium | flavum | 21475 | | | | | | | |
| Brevibacterium | flavum | 21517 | | | | | | | |
| Brevibacterium | flavum | 21528 | | | | | | | |
| Brevibacterium | flavum | 21529 | | | | | | | |
| Brevibacterium | flavum | | | B11477 | | | | | |
| Brevibacterium | flavum | | | B11478 | | | | | |
| Brevibacterium | flavum | 21127 | | | | | | | |
| Brevibacterium | flavum | | | B11474 | | | | | |
| Brevibacterium | healii | 15527 | | | | | | | |
| Brevibacterium | ketoglutamicum | 21004 | | | | | | | |
| Brevibacterium | ketoglutamicum | 21089 | | | | | | | |
| Brevibacterium | ketosoreductum | 21914 | | | | | | | |
| Brevibacterium | lactofermentum | | | | 70 | | | | |
| Brevibacterium | lactofermentum | | | | 74 | | | | |
| Brevibacterium | lactofermentum | | | | 77 | | | | |
| Brevibacterium | lactofermentum | 21798 | | | | | | | |
| Brevibacterium | lactofermentum | 21799 | | | | | | | |
| Brevibacterium | lactofermentum | 21800 | | | | | | | |
| Brevibacterium | lactofermentum | 21801 | | | | | | | |
| Brevibacterium | lactofermentum | | | B11470 | | | | | |
| Brevibacterium | lactofermentum | | | B11471 | | | | | |

| Genus | species | ATCC | FERM | NRRL | CECT | NCIMB | CBS | NCTC | DSMZ |
|-----------------|------------------|-------|------|--------|------|-------|--------|------|------|
| Brevibacterium | lactofermentum | 21086 | | | | | | | |
| Brevibacterium | lactofermentum | 21420 | | | | | | | |
| Brevibacterium | lactofermentum | 21086 | | | | | | | |
| Brevibacterium | lactofermentum | 31269 | | | | | | | |
| Brevibacterium | linens | 9174 | | | | | | | |
| Brevibacterium | linens | 19391 | | | | | | | |
| Brevibacterium | linens | 8377 | | | | | | | |
| Brevibacterium | paraffinolyticum | | | | | 11160 | | | |
| Brevibacterium | spec. | | | | | | 717.73 | | |
| Brevibacterium | spec. | | | | | | 717.73 | | |
| Brevibacterium | spec. | 14604 | | | | | | | |
| Brevibacterium | spec. | 21860 | | | | | | | |
| Brevibacterium | spec. | 21864 | | | | | | | |
| Brevibacterium | spec. | 21865 | | | | | | | |
| Brevibacterium | spec. | 21866 | | | | | | | |
| Brevibacterium | spec. | 19240 | | | | | | | |
| Corynebacterium | acetoacidophilum | 21476 | | | | | | | |
| Corynebacterium | acetoacidophilum | 13870 | | | | | | | |
| Corynebacterium | acetoglutamicum | | | B11473 | | | | | |
| Corynebacterium | acetoglutamicum | | | B11475 | | | | | |
| Corynebacterium | acetoglutamicum | 15806 | | | | | | | |
| Corynebacterium | acetoglutamicum | 21491 | | | | | | | |
| Corynebacterium | acetoglutamicum | 31270 | | | | | | | |
| Corynebacterium | acetophilum | | | B3671 | | | | | |
| Corynebacterium | ammoniagenes | 6872 | | | | | | 2399 | |
| Corynebacterium | ammoniagenes | 15511 | | | | | | | |
| Corynebacterium | fujiokense | 21496 | | | | | | | |
| Corynebacterium | glutamicum | 14067 | | | | | | | |
| Corynebacterium | glutamicum | 39137 | | | | | | | |
| Corynebacterium | glutamicum | 21254 | | | | | | | |
| Corynebacterium | glutamicum | 21255 | | | | | | | |
| Corynebacterium | glutamicum | 31830 | | | | | | | |
| Corynebacterium | glutamicum | 13032 | | | | | | | |
| Corynebacterium | glutamicum | 14305 | | | | | | | |
| Corynebacterium | glutamicum | 15455 | | | | | | | |
| Corynebacterium | glutamicum | 13058 | | | | | | | |
| Corynebacterium | glutamicum | 13059 | | | | | | | |
| Corynebacterium | glutamicum | 13060 | | | | | | | |
| Corynebacterium | glutamicum | 21492 | | | | | | | |
| Corynebacterium | glutamicum | 21513 | | | | | | | |
| Corynebacterium | glutamicum | 21526 | | | | | | | |
| Corynebacterium | glutamicum | 21543 | | | | | | | |
| Corynebacterium | glutamicum | 13287 | | | | | | | |
| Corynebacterium | glutamicum | 21851 | | | | | | | |
| Corynebacterium | glutamicum | 21253 | | | | | | | |
| Corynebacterium | glutamicum | 21514 | | | | | | | |
| Corynebacterium | glutamicum | 21516 | | | | | | | |
| Corynebacterium | glutamicum | 21299 | | | | | | | |

| Genus | species | ATCC | FERM | NRRL | CECT | NCIMB | GBS | NCTC | DSMZ |
|-----------------|------------|-------|------|--------|------|-------|-----|------|------|
| Corynebacterium | glutamicum | 21300 | | | | | | | |
| Corynebacterium | glutamicum | 39684 | | | | | | | |
| Corynebacterium | glutamicum | 21488 | | | | | | | |
| Corynebacterium | glutamicum | 21649 | | | | | | | |
| Corynebacterium | glutamicum | 21650 | | | | | | | |
| Corynebacterium | glutamicum | 19223 | | | | | | | |
| Corynebacterium | glutamicum | 13869 | | | | | | | |
| Corynebacterium | glutamicum | 21157 | | | | | | | |
| Corynebacterium | glutamicum | 21158 | | | | | | | |
| Corynebacterium | glutamicum | 21159 | | | | | | | |
| Corynebacterium | glutamicum | 21355 | | | | | | | |
| Corynebacterium | glutamicum | 31808 | | | | | | | |
| Corynebacterium | glutamicum | 21674 | | | | | | | |
| Corynebacterium | glutamicum | 21562 | | | | | | | |
| Corynebacterium | glutamicum | 21563 | | | | | | | |
| Corynebacterium | glutamicum | 21564 | | | | | | | |
| Corynebacterium | glutamicum | 21565 | | | | | | | |
| Corynebacterium | glutamicum | 21566 | | | | | | | |
| Corynebacterium | glutamicum | 21567 | | | | | | | |
| Corynebacterium | glutamicum | 21568 | | | | | | | |
| Corynebacterium | glutamicum | 21569 | | | | | | | |
| Corynebacterium | glutamicum | 21570 | | | | | | | |
| Corynebacterium | glutamicum | 21571 | | | | | | | |
| Corynebacterium | glutamicum | 21572 | | | | | | | |
| Corynebacterium | glutamicum | 21573 | | | | | | | |
| Corynebacterium | glutamicum | 21579 | | | | | | | |
| Corynebacterium | glutamicum | 19049 | | | | | | | |
| Corynebacterium | glutamicum | 19050 | | | | | | | |
| Corynebacterium | glutamicum | 19051 | | | | | | | |
| Corynebacterium | glutamicum | 19052 | | | | | | | |
| Corynebacterium | glutamicum | 19053 | | | | | | | |
| Corynebacterium | glutamicum | 19054 | | | | | | | |
| Corynebacterium | glutamicum | 19055 | | | | | | | |
| Corynebacterium | glutamicum | 19056 | | | | | | | |
| Corynebacterium | glutamicum | 19057 | | | | | | | |
| Corynebacterium | glutamicum | 19058 | | | | | | | |
| Corynebacterium | glutamicum | 19059 | | | | | | | |
| Corynebacterium | glutamicum | 19060 | | | | | | | |
| Corynebacterium | glutamicum | 19185 | | | | | | | |
| Corynebacterium | glutamicum | 13286 | | | | | | | |
| Corynebacterium | glutamicum | 21515 | | | | | | | |
| Corynebacterium | glutamicum | 21527 | | | | | | | |
| Corynebacterium | glutamicum | 21544 | | | | | | | |
| Corynebacterium | glutamicum | 21492 | | | | | | | |
| Corynebacterium | glutamicum | | | B8183 | | | | | |
| Corynebacterium | glutamicum | | | B8182 | | | | | |
| Corynebacterium | glutamicum | | | B12416 | | | | | |
| Corynebacterium | glutamicum | | | B12417 | | | | | |

| Genus | species | ATCC | FERM | NRRL | CECT | NCIMB | CBS | NCTC | DSMZ |
|-----------------|---------------|-------|-------|--------|------|-------|-----|------|-------|
| Corynebacterium | glutamicum | | | B12418 | | | | | |
| Corynebacterium | glutamicum | | | B11476 | | | | | |
| Corynebacterium | glutamicum | 21608 | | | | | | | |
| Corynebacterium | lilium | | P973 | | | | | | |
| Corynebacterium | nitrilophilus | 21419 | | | | 11594 | | | |
| Corynebacterium | spec. | | P4445 | | | | | | |
| Corynebacterium | spec. | | P4446 | | | | | | |
| Corynebacterium | spec. | 31088 | | | | | | | |
| Corynebacterium | spec. | 31089 | | | | | | | |
| Corynebacterium | spec. | 31090 | | | | | | | |
| Corynebacterium | spec. | 31090 | | | | | | | |
| Corynebacterium | spec. | 31090 | | | | | | | |
| Corynebacterium | spec. | 15954 | | | | | | | 20145 |
| Corynebacterium | spec. | 21857 | | | | | | | |
| Corynebacterium | spec. | 21862 | | | | | | | |
| Corynebacterium | spec. | 21863 | | | | | | | |

ATCC: American Type Culture Collection, Rockville, MD, USA

FERM: Fermentation Research Institute, Chiba, Japan

NRRL: ARS Culture Collection, Northern Regional Research Laboratory, Peoria, IL, USA

CECT: Coleccion Espanola de Cultivos Tipo, Valencia, Spain

NCIMB: National Collection of Industrial and Marine Bacteria Ltd., Aberdeen, UK

CBS: Centraalbureau voor Schimmelcultures, Baarn, NL

NCTC: National Collection of Type Cultures, London, UK

DSMZ: Deutsche Sammlung von Mikroorganismen und Zellkulturen, Braunschweig, Germany

For reference see Sugawara, H. et al. (1993) World directory of collections of cultures of microorganisms: Bacteria, fungi and yeasts (4th edn), World federation for culture collections world data center on microorganisms, Saimata, Japan.

TABLE 4: ALIGNMENT RESULTS

| ID # | length (NT) | Genbank Hit | Length | Accession | Name of Genbank Hit | Source of Genbank Hit | % homology (GAP) | Date of Deposit |
|---------|----------------|------------------|--------|-----------|---|----------------------------------|---------------------|--------------------|
| rx00062 | 1521 | GB_HTG2:AC007366 | 185001 | AC007366 | Homo sapiens clone NH0501G22, *** SEQUENCING IN PROGRESS ***; 3 unordered pieces. | Homo sapiens | 39,080 | 5-Jun-99 |
| rx00084 | 948 | GB_PR3:HSU80741 | 912 | U80741 | Homo sapiens CAGH44 mRNA, partial cds. | Homo sapiens | 39,264 | 18-DEC-1997 |
| | | GB_PL1:BNDNATRNA | 1732 | X89901 | B.nigra DNA for tRNA like gene. | Brassica nigra | 36,725 | 6-Feb-97 |
| | | GB_PR3:HSU80741 | 912 | U80741 | Homo sapiens CAGH44 mRNA, partial cds. | Homo sapiens | 38,957 | 18-DEC-1997 |
| rx00109 | 735 | GB_GSS9:AQ163721 | 388 | AQ163721 | HS_2245_A1_F07_MF CIT Approved Human Genomic Sperm Library D Homo sapiens genomic clone Plate=2245 Col=13 Row=K, genomic survey sequence. | Homo sapiens | 45,066 | 16-OCT-1998 |
| | | GB_HTG4:AC007054 | 171979 | AC007054 | Drosophila melanogaster chromosome 2 clone BACR45O18 (D527) RPCI-98 | Drosophila melanogaster | 36,589 | 13-OCT-1999 |
| | | | | | 45.O.18 map 41E-41E strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 13 unordered pieces. | | | |
| | | GB_HTG4:AC007054 | 171979 | AC007054 | Drosophila melanogaster chromosome 2 clone BACR45O18 (D527) RPCI-98 | Drosophila melanogaster | 36,589 | 13-OCT-1999 |
| | | | | | 45.O.18 map 41E-41E strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 13 unordered pieces. | | | |
| rx00215 | 1449 | GB_BA1:SC9C7 | 31360 | AL035161 | Streptomyces coelicolor cosmid 9C7. | Streptomyces coelicolor | 44,444 | 12-Jan-99 |
| | | GB_BA1:SCE94 | 38532 | AL049628 | Streptomyces coelicolor cosmid E94. | Streptomyces coelicolor | 36,313 | 12-Apr-99 |
| | | GB_BA2:AF110185 | 20302 | AF110185 | Burkholderia pseudomallei strain 1026b DbhB (dbhB), general secretory pathway protein D (gspD), general secretory pathway protein E (gspE), general secretory pathway protein F (gspF), GspC (gspC), general secretory pathway protein G (gspG), general secretory pathway protein H (gspH), general secretory pathway protein I (gspI), general secretory pathway protein J (gspJ), general secretory pathway protein K (gspK), general secretory pathway protein L (gspL), general secretory pathway protein M (gspM), and general secretory pathway protein N (gspN) genes, complete cds; and unknown genes. | Burkholderia pseudomallei | 44,159 | 2-Aug-99 |
| rx00289 | 1299 | GB_EST6:N80167 | 384 | N80167 | za65g02.s1 Soares fetal liver spleen 1NFLS Homo sapiens cDNA clone IMAGE:297458 3', mRNA sequence. | Homo sapiens | 40,420 | 29-MAR-1996 |
| | | GB_STS:G37084 | 384 | G37084 | SHGC-56832 Human Homo sapiens STS genomic, sequence tagged site. | Homo sapiens | 40,420 | 30-MAR-1998 |
| | | GB_STS:G37084 | 384 | G37084 | SHGC-56832 Human Homo sapiens STS genomic, sequence tagged site. | Homo sapiens | 40,420 | 30-MAR-1998 |
| rx00404 | 2439 | GB_BA1:MTCY22D7 | 31859 | Z83866 | Mycobacterium tuberculosis H37Rv complete genome; segment 133/162. | Mycobacterium tuberculosis | 60,271 | 17-Jun-98 |
| | | GB_BA1:ECU82598 | 136742 | U82598 | Escherichia coli genomic sequence of minutes 9 to 12. | Escherichia coli | 54,256 | 15-Jan-97 |
| | | GB_BA2:AE000165 | 12003 | AE000165 | Escherichia coli K-12 MG1655 section 55 of 400 of the complete genome. | Escherichia coli | 54,256 | 12-Nov-98 |
| rx00479 | 2313 | GB_BA1:SCF43A | 35437 | AL096837 | Streptomyces coelicolor cosmid F43A. | Streptomyces coelicolor | 36,245 | 13-Jul-99 |
| | | GB_GSS2:CNS015U4 | 1036 | AL105910 | Drosophila melanogaster genome survey sequence SP6 end of BAC BACN14G08 of DrosBAC library from Drosophila melanogaster (fruit fly), genomic survey sequence. | A3(2) Drosophila melanogaster | 37,573 | 26-Jul-99 |

Table 4 (continued)

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| | | | | | | | | |
|----------|------|-------------------|--------|----------|--|-------------------------------------|--------|-------------|
| rxa00497 | 420 | GB_PR3:HSA494O16 | 50502 | AL117328 | Human DNA sequence from clone 494O16 on chromosome 22, complete sequence. | Homo sapiens | 36,475 | 23-Nov-99 |
| | | GB_BA1:MTCY78 | 33818 | Z77165 | Mycobacterium tuberculosis H37Rv complete genome; segment 145/162. | Mycobacterium tuberculosis | 40,250 | 17-Jun-98 |
| | | GB_BA2:AF079544 | 817 | AF079544 | Mycobacterium avium GroESL operon, partial sequence. | Mycobacterium avium | 64,439 | 16-Aug-98 |
| | | GB_BA1:MTGROEOP | 2987 | X60350 | M.tuberculosis groE gene for KCS and 10-kDa products. | Mycobacterium tuberculosis | 62,857 | 23-Apr-92 |
| rxa00575 | | | | | | | | |
| rxa00599 | 510 | GB_GSS10:AQ199703 | 439 | AQ199703 | RPC11-46O13.TJ RPC1-11 Homo sapiens genomic clone RPC1-11-46O13, genomic survey sequence. | Homo sapiens | 42,657 | 20-Apr-99 |
| | | GB_PR2:AC002127 | 144165 | AC002127 | Human BAC clone RG305H12 from 7q21, complete sequence. | Homo sapiens | 37,052 | 27-MAY-1997 |
| rxa00600 | 1221 | GB_STS:G51234 | 439 | G51234 | SHGC-80708 Human Homo sapiens STS genomic, sequence tagged site. | Homo sapiens | 42,657 | 25-Jun-99 |
| | | GB_BA1:MTCY441 | 35187 | Z80225 | Mycobacterium tuberculosis H37Rv complete genome; segment 118/162. | Mycobacterium tuberculosis | 56,183 | 18-Jun-98 |
| | | GB_BA1:MSGY223 | 42061 | AD000019 | Mycobacterium tuberculosis sequence from clone y223. | Mycobacterium tuberculosis | 37,217 | 10-DEC-1996 |
| rxa00605 | 1603 | GB_BA1:BSUB0014 | 213420 | Z99117 | Bacillus subtilis complete genome (section 14 of 21): from 2599451 to 2812870. | Bacillus subtilis | 36,553 | 26-Nov-97 |
| | | GB_BA2:AF069070 | 2776 | AF069070 | Endosymbiont of Onchocerca volvulus catalase gene, complete cds. | endosymbiont of Onchocerca volvulus | 55,396 | 25-Nov-98 |
| | | GB_BA1:OVCAT | 1845 | X82176 | Onchocerca volvulus endobacterial mRNA for catalase. | Onchocerca volvulus | 55,396 | 26-Nov-98 |
| rxa00648 | 1533 | GB_BA1:SC2G5 | 38404 | AL035478 | Streptomyces coelicolor cosmid 2G5. | Streptomyces coelicolor | 39,530 | 11-Jun-99 |
| | | GB_HTG1:HS74O16 | 169401 | AL110119 | Homo sapiens chromosome 21 clone RPCIP704O1674 map 21q21, *** SEQUENCING IN PROGRESS ***, in unordered pieces. | Homo sapiens | 36,327 | 27-Aug-99 |
| | | GB_HTG1:HS74O16 | 169401 | AL110119 | Homo sapiens chromosome 21 clone RPCIP704O1674 map 21q21, *** SEQUENCING IN PROGRESS ***, in unordered pieces. | Homo sapiens | 36,327 | 27-Aug-99 |
| | | GB_HTG1:HS74O16 | 169401 | AL110119 | Homo sapiens chromosome 21 clone RPCIP704O1674 map 21q21, *** SEQUENCING IN PROGRESS ***, in unordered pieces. | Homo sapiens | 35,119 | 27-Aug-99 |
| rxa00764 | 1239 | GB_EST36:A1898007 | 609 | A1898007 | EST267450 tomato ovary, TAMU Lycopersicon esculentum cDNA clone cLED31K22, mRNA sequence. | Lycopersicon esculentum | 34,323 | 27-Jul-99 |
| | | GB_BA2:PAU93274 | 8008 | U93274 | Pseudomonas aeruginosa YafE (yafE), LeuB (leuB), Asd (asd), FimV (fimV), and HisT (hisT) genes, complete cds; TrpF (trpF) gene, partial cds; and unknown | Pseudomonas aeruginosa | 35,895 | 23-Jun-98 |
| | | GB_BA2:PAU93274 | 8008 | U93274 | Pseudomonas aeruginosa YafE (yafE), LeuB (leuB), Asd (asd), FimV (fimV), and HisT (hisT) genes, complete cds; TrpF (trpF) gene, partial cds; and unknown | Pseudomonas aeruginosa | 41,417 | 23-Jun-98 |
| rxa00803 | 1353 | GB_IN2:CELH34C03 | 27748 | AF100662 | Caenorhabditis elegans cosmid H34C03. | Caenorhabditis elegans | 34,152 | 28-OCT-1998 |
| | | GB_HTG2:AC007905 | 100722 | AC007905 | Homo sapiens chromosome 16q24.3 clone PAC 754F23, *** SEQUENCING IN PROGRESS ***, 33 unordered pieces. | Homo sapiens | 37,472 | 24-Jun-99 |
| | | GB_HTG2:AC007905 | 100722 | AC007905 | Homo sapiens chromosome 16q24.3 clone PAC 754F23, *** SEQUENCING IN PROGRESS ***, 33 unordered pieces. | Homo sapiens | 37,472 | 24-Jun-99 |

PCT/IB00/00922

Table 4 (continued)

| | | | | | | | | |
|----------|------|---------------------|----------|----------|---|----------------------------|--------|-------------|
| rx000810 | 324 | GB_BA1:MTY15C10 | 33050 | Z95436 | Mycobacterium tuberculosis H37Rv complete genome; segment 154/162. | Mycobacterium tuberculosis | 34,615 | 17-Jun-98 |
| rx000829 | 2463 | GB_BA1:MLCB2548 | 38916 | AL023093 | Mycobacterium leprae cosmid B2548. | Mycobacterium leprae | 34,615 | 27-Aug-99 |
| | | GB_BA1:ECOUW76 | 225419 | U00039 | E. coli chromosomal region from 76.0 to 81.5 minutes. | Escherichia coli | 52,997 | 7-Nov-96 |
| | | GB_BA1:SC5C7 | 41906 | AL031515 | Streptomyces coelicolor cosmid 5C7. | Streptomyces coelicolor | 65,269 | 7-Sep-98 |
| | | GB_BA1:SC5F2A | 40105 | AL049587 | Streptomyces coelicolor cosmid 5F2A. | Streptomyces coelicolor | 37,490 | 24-MAY-1999 |
| rx000843 | 468 | GB_BA1:STMDRRRC | 3374 | L76359 | Streptomyces peucetius daunorubicin resistance protein (drrC) gene, complete | Streptomyces peucetius | 55,279 | 24-DEC-1996 |
| | | GB_BA1:MTCY9C4 | 15916 | Z77250 | Mycobacterium tuberculosis H37Rv complete genome; segment 113/162. | Mycobacterium tuberculosis | 40,000 | 17-Jun-98 |
| | | GB_BA1:MTCY9C4 | 15916 | Z77250 | Mycobacterium tuberculosis H37Rv complete genome; segment 113/162. | Mycobacterium tuberculosis | 37,773 | 17-Jun-98 |
| rx000858 | 568 | GB_BA1:SCC54 | 30753 | AL035591 | Streptomyces coelicolor cosmid C54. | Streptomyces coelicolor | 39,602 | 11-Jun-99 |
| | | GB_EST18:N96610 | 547 | N96610 | 21285 Lambda-PRL1 Arabidopsis thaliana cDNA clone F10G3T7, mRNA | Arabidopsis thaliana | 37,801 | 5-Jan-98 |
| | | GB_EST18:T45493 | 436 | T45493 | 8756 Lambda-PRL2 Arabidopsis thaliana cDNA clone 133C14T7, mRNA | Arabidopsis thaliana | 34,194 | 4-Aug-98 |
| | | GB_BA1:SYCSLLH | 132106 | D64006 | Synechocystis sp. PCC6803 complete genome, 25/27, 3138604-3270709. | Synechocystis sp. | 37,459 | 13-Feb-99 |
| | | GB_BA1:SCDNAJ | 5611 | X77458 | S.coelicolor dnaK, grpE and dnaJ genes. | Streptomyces coelicolor | 49,744 | 21-Nov-96 |
| rx000900 | 975 | GB_BA1:STMDNAK | 4648 | L46700 | Streptomyces coelicolor (strain A3(2)) dnaK operon encoding molecular chaperones (dnaK, dnaJ), grpE and hspR genes, complete cds's. | Streptomyces coelicolor | 49,583 | 22-Nov-96 |
| | | GB_BA2:ECOUW67_0 | 110000 | U18997 | Escherichia coli K-12 chromosomal region from 67.4 to 76.0 minutes. | Escherichia coli | 38,314 | U18997 |
| | | GB_BA2:ECOUW67_0 | 110000 | U18997 | Escherichia coli K-12 chromosomal region from 67.4 to 76.0 minutes. | Escherichia coli | 37,759 | U18997 |
| | | GB_BA2:AE000393 | 10516 | AE000393 | Escherichia coli K-12 MG1655 section 283 of 400 of the complete genome. | Escherichia coli | 38,314 | 12-Nov-98 |
| | | GB_HTG3:AC010757 | 175571 | AC010757 | Homo sapiens chromosome 18 clone 128_C_18 map 18, *** SEQUENCING IN PROGRESS ***, 20 unordered pieces. | Homo sapiens | 34,857 | 22-Sep-99 |
| rx000981 | 753 | GB_HTG3:AC010757 | 175571 | AC010757 | Homo sapiens chromosome 18 clone 128_C_18 map 18, *** SEQUENCING IN PROGRESS ***, 20 unordered pieces. | Homo sapiens | 34,857 | 22-Sep-99 |
| | | GB_HTG3:AC011283 | 87295 | AC011283 | Homo sapiens clone MS2016A09, *** SEQUENCING IN PROGRESS ***, 1 unordered pieces. | Homo sapiens | 35,448 | 07-OCT-1999 |
| | | GB_OV:GGA245664 | 512 | AJ245664 | Gallus gallus partial mRNA for ATP-citrate lyase (ACL gene). | Gallus gallus | 37,538 | 28-Sep-99 |
| | | GB_PL2:AC007887 | 159434 | AC007887 | Genomic sequence for Arabidopsis thaliana BAC F15O4 from chromosome I, complete sequence. | Arabidopsis thaliana | 37,600 | 04-OCT-1999 |
| | | GB_GSS1:CNS00RNW542 | AL087338 | AL087338 | Arabidopsis thaliana genome survey sequence T7 end of BAC F14D7 of IGF library from strain Columbia of Arabidopsis thaliana, genomic survey sequence. | Arabidopsis thaliana | 41,264 | 28-Jun-99 |
| rx000995 | 864 | GB_EST29:AI553951 | 450 | AI553951 | te54d01.x1 Soares_NFL_T_GBC_S1 Homo sapiens cDNA clone IMAGE:2090497 3' similar to gb:X02067 H.sapiens mRNA for 7SL RNA pseudogene (HUMAN);, mRNA sequence. | Homo sapiens | 42,627 | 13-Apr-99 |
| | | GB_PR3:AC003029 | 139166 | AC003029 | Homo sapiens Chromosome 12q24 PAC RPC13-462E2 (Roswell Park Cancer Institute Human PAC library) complete sequence. | Homo sapiens | 38,915 | 17-Sep-98 |
| | | GB_BA1:EAY14603 | 4479 | Y14603 | Erwinia amylovora srlA, srlE, srlB, srlD, srlM and srlR genes. | Erwinia amylovora | 37,694 | 6-Jan-98 |
| rx000996 | 864 | GB_BA2:AE001001 | 10730 | AE001001 | Archaeoglobus fulgidus section 106 of 172 of the complete genome. | Archaeoglobus fulgidus | 41,078 | 15-DEC-1997 |
| | | GB_EST30:AV018764 | 242 | AV018764 | AV018764 Mus musculus 18-day embryo C57BL/6J Mus musculus cDNA clone 1190006M16, mRNA sequence. | Mus musculus | 39,669 | 28-Aug-99 |

Table 4 (continued)

| | | | | | | | |
|--------------|-----------------------|--------|----------|---|-------------------------------|--------|-------------|
| rx01408 324 | GB_HTG3:AC010831 | 70233 | AC010831 | Homo sapiens clone 6_L_24, LOW-PASS SEQUENCE SAMPLING. | Homo sapiens | 35,764 | 23-Sep-99 |
| | GB_PR3:AC004058 | 38400 | AC004058 | Homo sapiens chromosome 4 clone B241P19 map 4q25, complete sequence. | Homo sapiens | 40,778 | 30-Sep-98 |
| | GB_PR4:AF152365 | 246546 | AF152365 | Homo sapiens constitutive fragile region FRA3B sequence. | Homo sapiens | 41,234 | 1-Aug-99 |
| | GB_HTG3:AC007890 | 121256 | AC007890 | Drosophila melanogaster chromosome 3 clone BACR02G21 (D722) RPCI-98 02.G.21 map 90E-91A strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 89 unordered pieces. | Drosophila melanogaster | 39,432 | 3-Sep-99 |
| rx01524 1566 | GB_HTG3:AC007890 | 121256 | AC007890 | Drosophila melanogaster chromosome 3 clone BACR02G21 (D722) RPCI-98 02.G.21 map 90E-91A strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 89 unordered pieces. | Drosophila melanogaster | 39,432 | 3-Sep-99 |
| | GB_BA1:BSUB0015 | 218410 | Z99118 | Bacillus subtilis complete genome (section 15 of 21); from 2795131 to 3013540. | Bacillus subtilis | 38,201 | 26-Nov-97 |
| | GB_HTG2:AC008260 | 107439 | AC008260 | Drosophila melanogaster chromosome 2 clone BACR13J10 (D924) RPCI-98 13.J.10 map 47B-47C strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 82 unordered pieces. | Drosophila melanogaster | 38,302 | 2-Aug-99 |
| | GB_HTG2:AC008260 | 107439 | AC008260 | Drosophila melanogaster chromosome 2 clone BACR13J10 (D924) RPCI-98 13.J.10 map 47B-47C strain y; cn bw sp, *** SEQUENCING IN PROGRESS ***, 82 unordered pieces. | Drosophila melanogaster | 38,302 | 2-Aug-99 |
| rx01578 1510 | GB_PR4:AF111170 | 148083 | AF111170 | Homo sapiens 14q32 Jagged2 gene, complete cds; and unknown gene. | Homo sapiens | 37,873 | 14-Jul-99 |
| | GB_PR4:AF111170 | 148083 | AF111170 | Homo sapiens 14q32 Jagged2 gene, complete cds; and unknown gene. | Homo sapiens | 40,220 | 14-Jul-99 |
| | GB_BA1:AEY13732 | 6740 | Y13732 | Alcaligenes eutrophus genes for ureases, ureD1, ureD2, ureA, ureB, and ORF1, ORF2. | Ralstonia eutropha | 42,960 | 23-Sep-97 |
| | GB_BA2:AF088857 | 2908 | AF088857 | Vogesella indigofera indigoidine biosynthesis regulatory locus, complete Caenorhabditis elegans cosmid M04D8, complete sequence. | Vogesella indigofera | 37,626 | 10-Sep-99 |
| rx01616 1605 | GB_IN1:CEM04D8 | 21552 | Z32682 | Caenorhabditis elegans cosmid M04D8, complete sequence. | Caenorhabditis elegans | 37,237 | 23-Nov-98 |
| | GB_EST25:A1281910 | 276 | A1281910 | qt82d04.x1 NCI_CGAP_Co14 Homo sapiens cDNA clone IMAGE:1961767 3', mRNA sequence. | Homo sapiens | 38,406 | 21-DEC-1998 |
| | GB_BA1:CGU43535 | 2531 | U43535 | Corynebacterium glutamicum multidrug resistance protein (cmr) gene, complete cds. | Corynebacterium glutamicum | 99,933 | 9-Apr-97 |
| | GB_HTG3:AC009213 | 114735 | AC009213 | Drosophila melanogaster chromosome 3 clone BACR09F18 (D812) RPCI-98 09.F.18 map 98D-98D strain y; cn bw sp, *** SEQUENCING IN PROGRESS ***, 109 unordered pieces. | Drosophila melanogaster | 36,111 | 23-Aug-99 |
| rx01666 1500 | GB_HTG3:AC009213 | 114735 | AC009213 | Drosophila melanogaster chromosome 3 clone BACR09F18 (D812) RPCI-98 09.F.18 map 98D-98D strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 109 unordered pieces. | Drosophila melanogaster | 36,111 | 23-Aug-99 |
| | GB_PL1:AB017159 | 1859 | AB017159 | Daucus carota mRNA for citrate synthase, complete cds. | Daucus carota | 39,537 | 01-MAY-1999 |
| | GB_PR1:HUMGNOS4823142 | D26607 | D26607 | Homo sapiens endothelial nitric oxide synthase gene, complete cds. | Homo sapiens | 36,419 | 13-Jul-99 |
| | GB_HTG3:AC011234 | 154754 | AC011234 | Homo sapiens clone NH0166D23, *** SEQUENCING IN PROGRESS ***, 7 unordered pieces. | Homo sapiens | 36,317 | 04-OCT-1999 |
| rx01873 1359 | GB_HTG3:AC009450 | 124337 | AC009450 | Homo sapiens chromosome 9 clone 30_C_23 map 9, *** SEQUENCING IN PROGRESS ***, 20 unordered pieces. | Homo sapiens | 35,303 | 22-Aug-99 |
| | GB_HTG3:AC009450 | 124337 | AC009450 | Homo sapiens chromosome 9 clone 30_C_23 map 9, *** SEQUENCING IN PROGRESS ***, 20 unordered pieces. | Homo sapiens | 35,303 | 22-Aug-99 |
| | GB_HTG3:AC009919 | 134724 | AC009919 | Homo sapiens clone 115_L_23, LOW-PASS SEQUENCE SAMPLING. | Homo sapiens | 35,409 | 8-Sep-99 |
| | GB_BA1:ECONEC | 1676 | M84026 | E. coli protein p7 (neu C) gene, complete cds. | Escherichia coli | 35,189 | 26-Apr-93 |
| rx01922 1275 | | | | | | | |

Table 4 (continued)

| | | | | | | | |
|--------------|-------------------|--------|----------|---|--------------------------------|---------|-------------|
| | GB_HTG2:AC007853 | 116280 | AC007853 | Drosophila melanogaster chromosome 3 clone BACR03L02 (D766) RPCI-98 03.L.2 map 96B-96C strain y; cn bw sp, *** SEQUENCING IN PROGRESS ***, 80 unordered pieces. | Drosophila melanogaster | 34,365 | 2-Aug-99 |
| | GB_HTG2:AC007853 | 116280 | AC007853 | Drosophila melanogaster chromosome 3 clone BACR03L02 (D766) RPCI-98 03.L.2 map 96B-96C strain y; cn bw sp, *** SEQUENCING IN PROGRESS ***, 80 unordered pieces. | Drosophila melanogaster | 34,365 | 2-Aug-99 |
| rx01936 1395 | GB_HTG4:AC010037 | 166249 | AC010037 | Drosophila melanogaster chromosome 3L/66B6 clone RPCI98-6E4, *** SEQUENCING IN PROGRESS ***, 52 unordered pieces. | Drosophila melanogaster | 38,534 | 16-OCT-1999 |
| | GB_HTG4:AC010037 | 166249 | AC010037 | Drosophila melanogaster chromosome 3L/66B6 clone RPCI98-6E4, *** SEQUENCING IN PROGRESS ***, 52 unordered pieces. | Drosophila melanogaster | 38,534 | 16-OCT-1999 |
| rx01984 420 | GB_PR4:AC005552 | 167228 | AC005552 | Homo sapiens chromosome 17, clone hRPK.212_E_8, complete sequence. | Homo sapiens | 36,249 | 26-Nov-98 |
| | GB_PR1:HS169C8F | 245 | Z57239 | H. sapiens CpG island DNA genomic Mse1 fragment, clone 169c8, forward read cpg169c8.ft1a. | Homo sapiens | 45,679 | 18-OCT-1995 |
| | GB_BA1:SERATTBXIS | 3255 | L11597 | Saccharopolyspora erythraea excisionase (xis) gene, integrase (int) gene, complete cds's and attB site. | Saccharopolyspora erythraea | 36,232 | 6-Jul-94 |
| | GB_EST7:W97557 | 267 | W97557 | m198a09.r1 Soares mouse embryo NbME13.5 14.5 Mus musculus cDNA clone IMAGE:422296 5', mRNA sequence. | Mus musculus | 42,969 | 16-Jul-96 |
| rx02060 | | | | | | | |
| rx02087 1470 | GB_PR3:AC005544 | 169045 | AC005544 | Homo sapiens chromosome 17, clone hRPK.349_A_8, complete sequence. | Homo sapiens | 35,724 | 25-Sep-98 |
| | GB_PL1:ATF20B18 | 104738 | AL049483 | Arabidopsis thaliana DNA chromosome 4, BAC clone F20B18 (ESSA project). | Arabidopsis thaliana | 35,890 | 24-MAR-1999 |
| rx02088 1338 | GB_PL2:ATT25K17 | 89904 | AL049171 | Arabidopsis thaliana DNA chromosome 4, BAC clone (ESSA project). | Arabidopsis thaliana | 38,128 | 27-Aug-99 |
| | GB_HTG3:AC008697 | 167932 | AC008697 | Homo sapiens chromosome 5 clone CIT978SKB_70D3, *** SEQUENCING IN PROGRESS ***, 54 unordered pieces. | Homo sapiens | 36,662 | 3-Aug-99 |
| | GB_HTG3:AC008697 | 167932 | AC008697 | Homo sapiens chromosome 5 clone CIT978SKB_70D3, *** SEQUENCING IN PROGRESS ***, 54 unordered pieces. | Homo sapiens | 36,662 | 3-Aug-99 |
| | GB_HTG3:AC008703 | 213971 | AC008703 | Homo sapiens chromosome 5 clone CIT978SKB_76P12, *** SEQUENCING IN PROGRESS ***, 54 unordered pieces. | Homo sapiens | 34,768 | 3-Aug-99 |
| rx02159 636 | GB_BA2:AF049897 | 9196 | AF049897 | Corynebacterium glutamicum N-acetylglutamylphosphate reductase (argC), ornithine acetyltransferase (argJ), N-acetylglutamate kinase (argB), acetylornithine transaminase (argD), ornithine carbamoyltransferase (argF), arginine repressor (argR), argininosuccinate synthase (argG), and argininosuccinate lyase (argH) genes, complete cds. | Corynebacterium glutamicum | 99,843 | 1-Jul-98 |
| | GB_BA2:AF031518 | 2045 | AF031518 | Corynebacterium glutamicum ornithine carbamoyltransferase (argF) gene, complete cds. | Corynebacterium glutamicum | 88,679 | 5-Jan-99 |
| | GB_BA2:AF041436 | 516 | AF041436 | Corynebacterium glutamicum arginine repressor (argR) gene, complete cds. | Corynebacterium glutamicum | 100,000 | 5-Jan-99 |
| rx02184 504 | GB_BA1:BSZ92953 | 8164 | Z92953 | B. subtilis yws[A,B,C] genes and rbs[A,C,D,K,R] genes. | Bacillus subtilis | 38,951 | 24-Jun-98 |
| | GB_EST36:AI878071 | 593 | AI878071 | fc57a12.y1 Zebrafish WashU MPIMG EST Danio rerio cDNA 5' similar to TR:Q13151 Q13151 HETEROGENEOUS NUCLEAR RIBONUCLEOPROTEIN A0 :, mRNA sequence. | Danio rerio | 36,774 | 21-Jul-99 |

Table 4 (continued)

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| | | | | | | | | |
|----------|------|-------------------|--------|----------|---|---------------------------|--------|-------------|
| rxa02200 | 1233 | GB_EST37:AI958166 | 641 | AI958166 | fc91f01.y1 Zebrafish WashU MPIMG EST Danio rerio cDNA 5' similar to TR:Q13151 Q13151 HETEROGENEOUS NUCLEAR RIBONUCLEOPROTEIN A0 ;, mRNA sequence. | Danio rerio | 36,774 | 20-Aug-99 |
| | | GB_PR3:HSA494O16 | 50502 | AL117328 | Human DNA sequence from clone 494O16 on chromosome 22, complete sequence. | Homo sapiens | 38,648 | 23-Nov-99 |
| | | GB_HTG2:AC008161 | 158440 | AC008161 | Mus musculus clone 182_H_5, *** SEQUENCING IN PROGRESS *** , 29 unordered pieces. | Mus musculus | 35,938 | 28-Jul-99 |
| | | GB_HTG2:AC008161 | 158440 | AC008161 | Mus musculus clone 182_H_5, *** SEQUENCING IN PROGRESS *** , 29 unordered pieces. | Mus musculus | 35,938 | 28-Jul-99 |
| rxa02201 | 486 | GB_EST4:H16949 | 465 | H16949 | ym34a11.r1 Soares infant brain 1NIB Homo sapiens cDNA clone IMAGE:50010 5', Homo sapiens mRNA sequence. | Homo sapiens | 38,267 | 29-Jun-95 |
| | | GB_EST4:H16949 | 465 | H16949 | ym34a11.r1 Soares infant brain 1NIB Homo sapiens cDNA clone IMAGE:50010 5', Homo sapiens mRNA sequence. | Homo sapiens | 36,552 | 29-Jun-95 |
| rxa02202 | 762 | GB_IN1:CELC41A3 | 37149 | U41541 | Caenorhabditis elegans cosmid C41A3. | Caenorhabditis elegans | 41,678 | 08-DEC-1995 |
| | | GB_EST33:AV080151 | 236 | AV080151 | AV080151 Mus musculus stomach C57BL/6J adult Mus musculus cDNA clone 2210413B04, mRNA sequence. | Mus musculus | 43,348 | 25-Jun-99 |
| | | GB_GSS5:AQ766877 | 545 | AQ766877 | HS_2017_B2_B08_MR CIT Approved Human Genomic Sperm Library D Homo sapiens genomic clone Plate=2017 Col=16 Row=D, genomic survey sequence. | Homo sapiens | 35,568 | 28-Jul-99 |
| rxa02205 | 1002 | GB_HTG2:AC005959 | 127587 | AC005959 | Homo sapiens, *** SEQUENCING IN PROGRESS *** , 2 ordered pieces. | Homo sapiens | 40,310 | 11-Nov-98 |
| | | GB_HTG2:AC005959 | 127587 | AC005959 | Homo sapiens, *** SEQUENCING IN PROGRESS *** , 2 ordered pieces. | Homo sapiens | 40,310 | 11-Nov-98 |
| | | GB_IN1:BRPTUBBA | 4571 | M36380 | B.pahangi beta-tubulin gene, complete cds. | Brugia pahangi | 37,703 | 26-Apr-93 |
| rxa02305 | 975 | GB_RO:MUSPAFR | 1140 | D50872 | Mouse gene for platelet activating factor receptor, complete cds. | Mus musculus | 38,420 | 10-Feb-99 |
| | | GB_PR3:HUMARL1A | 1008 | L28997 | Homo sapiens ARL1 mRNA, complete cds. | Homo sapiens | 42,188 | 13-Jan-95 |
| | | GB_BA1:MLCB2533 | 40245 | AL035310 | Mycobacterium leprae cosmid B2533. | Mycobacterium leprae | 42,000 | 27-Aug-99 |
| rxa02431 | 899 | GB_EST4:H35255 | 407 | H35255 | EST111890 Rat PC-12 cells, NGF-treated (9 days) Rattus sp. cDNA clone RPNCO03, mRNA sequence. | Rattus sp. | 39,098 | 2-Apr-98 |
| | | GB_HTG1:HS791K14 | 155318 | AL035685 | Homo sapiens chromosome 20 clone RP4-791K14, *** SEQUENCING IN PROGRESS *** , in unordered pieces. | Homo sapiens | 39,456 | 23-Nov-99 |
| | | GB_HTG1:HS791K14 | 155318 | AL035685 | Homo sapiens chromosome 20 clone RP4-791K14, *** SEQUENCING IN PROGRESS *** , in unordered pieces. | Homo sapiens | 39,456 | 23-Nov-99 |
| rxa02446 | 558 | GB_BA2:AF036166 | 895 | AF036166 | Xanthomonas campestris organic hydroperoxide resistance protein (ohr) gene, complete cds. | Xanthomonas campestris | 49,369 | 19-MAY-1998 |
| | | GB_EST5:N25122 | 620 | N25122 | yx19d10.r1 Soares melanocyte 2NbHM Homo sapiens cDNA clone IMAGE:262195 5', mRNA sequence. | Homo sapiens | 35,417 | 28-DEC-1995 |
| | | GB_EST5:N25122 | 620 | N25122 | yx19d10.r1 Soares melanocyte 2NbHM Homo sapiens cDNA clone IMAGE:262195 5', mRNA sequence. | Homo sapiens | 37,172 | 28-DEC-1995 |
| rxa02541 | 1308 | GB_BA2:DPU93358 | 1267 | U93358 | Deinococcus proteolyticus 40 kDa heat shock chaperone protein (dnaJ) gene, complete cds. | Deinococcus proteolyticus | 42,115 | 17-Jan-98 |
| | | GB_EST30:A1658096 | 343 | A1658096 | fc14c09.y1 Zebrafish WashU MPIMG EST Danio rerio cDNA 5' similar to SW:DNJ2_HUMAN P31689 DNAJ PROTEIN HOMOLOG 2. ;, mRNA sequence. | Danio rerio | 52,059 | 06-MAY-1999 |
| | | GB_EST37:AI959242 | 545 | AI959242 | fd25h11.y1 Zebrafish WashU MPIMG EST Danio rerio cDNA 5' similar to SW:DNJ2_HUMAN P31689 DNAJ PROTEIN HOMOLOG 2. ;, mRNA sequence. | Danio rerio | 45,438 | 20-Aug-99 |

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Table 4 (continued)

| | | | | | | | | |
|---------------|---------------------|--------|----------|--|---|---|--------|--|
| rxa02542 777 | EM_PAT:E10832 | 1856 | E10832 | | DNA encoding Dnak protein which is one of heat shock protein from | Corynebacterium glutamicum | 99,000 | 08-OCT-1997 (Rel. 52, Created) 30-Apr-99 |
| rxs02543 1977 | GB_EST24:Z82017 | 396 | Z82017 | | SSZ82017 Porcine small intestine cDNA library Sus scrofa cDNA clone c12c06 5' similar to eukaryotic initiation factor 4 gamma, mRNA sequence. | Sus scrofa | 37,067 | |
| | GB_OM:CATERYTHRO681 | | L10606 | | Cat erythropoietin mRNA, 3' end. | Felis catus | 39,409 | 14-OCT-1993 |
| | EM_PAT:E10832 | 1856 | E10832 | | DNA encoding Dnak protein which is one of heat shock protein from | Corynebacterium glutamicum | 97,306 | 08-OCT-1997 (Rel. 52, Created) |
| rxs02586 393 | GB_BA1:MPHSP70 | 2179 | X59437 | | M.paratuberculosis gene for 70 kD heat shock protein. | Mycobacterium avium subsp. paratuberculosis | 73,404 | 23-Apr-92 |
| | GB_BA1:MTY13E10 | 35019 | Z95324 | | Mycobacterium tuberculosis H37Rv complete genome; segment 18/162. | Mycobacterium tuberculosis | 72,028 | 17-Jun-98 |
| | GB_IN2:AC006472 | 156362 | AC006472 | | Drosophila melanogaster, chromosome 2R, region 45E1-46A2, BAC clone BACR48G21, complete sequence. | Drosophila melanogaster | 37,958 | 30-Jan-99 |
| rxs02587 2214 | GB_HTG4:AC010020 | 106541 | AC010020 | | Drosophila melanogaster chromosome 3L/66D10 clone RPCI98-2613, *** SEQUENCING IN PROGRESS *** | Drosophila melanogaster | 37,333 | 16-OCT-1999 |
| | GB_HTG4:AC010020 | 106541 | AC010020 | | Drosophila melanogaster chromosome 3L/66D10 clone RPCI98-2613, *** SEQUENCING IN PROGRESS *** | Drosophila melanogaster | 37,333 | 16-OCT-1999 |
| | GB_BA1:MLCL622 | 42498 | Z95398 | | Mycobacterium leprae cosmid L622. | Mycobacterium leprae | 39,848 | 24-Jun-97 |
| rxs03217 331 | GB_RO:AF074879 | 3316 | AF074879 | | Rattus norvegicus testis-specific protein TSPY gene, complete cds. | Rattus norvegicus | 35,830 | 6-Jul-99 |
| | GB_RO:RNJ001380 | 2641 | AJ001380 | | Rattus norvegicus Tspy partial genomic sequence, exons 1-6. | Rattus norvegicus | 37,702 | 29-Jun-98 |
| | GB_BA1:MLCB2548 | 38916 | AL023093 | | Mycobacterium leprae cosmid B2548. | Mycobacterium leprae | 37,888 | 27-Aug-99 |
| | GB_HTG2:HSJ662M14 | 174772 | AL079336 | | Homo sapiens chromosome 20 clone RP4-662M14, *** SEQUENCING IN PROGRESS *** | Homo sapiens | 36,420 | 4-Feb-00 |
| rxs03217 331 | GB_HTG2:HSJ662M14 | 174772 | AL079336 | | Homo sapiens chromosome 20 clone RP4-662M14, *** SEQUENCING IN PROGRESS *** | Homo sapiens | 35,962 | 4-Feb-00 |

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Exemplification

Example 1: Preparation of total genomic DNA of *Corynebacterium glutamicum* ATCC 13032

5 A culture of *Corynebacterium glutamicum* (ATCC 13032) was grown overnight at 30°C with vigorous shaking in BHI medium (Difco). The cells were harvested by centrifugation, the supernatant was discarded and the cells were resuspended in 5 ml buffer-I (5% of the original volume of the culture — all indicated volumes have been calculated for 100 ml of culture volume). Composition of buffer-I: 140.34 g/l sucrose,
10 2.46 g/l $\text{MgSO}_4 \times 7\text{H}_2\text{O}$, 10 ml/l KH_2PO_4 solution (100 g/l, adjusted to pH 6.7 with KOH), 50 ml/l M12 concentrate (10 g/l $(\text{NH}_4)_2\text{SO}_4$, 1 g/l NaCl, 2 g/l $\text{MgSO}_4 \times 7\text{H}_2\text{O}$, 0.2 g/l CaCl_2 , 0.5 g/l yeast extract (Difco), 10 ml/l trace-elements-mix (200 mg/l $\text{FeSO}_4 \times \text{H}_2\text{O}$, 10 mg/l $\text{ZnSO}_4 \times 7 \text{H}_2\text{O}$, 3 mg/l $\text{MnCl}_2 \times 4 \text{H}_2\text{O}$, 30 mg/l H_3BO_3 , 20 mg/l $\text{CoCl}_2 \times 6 \text{H}_2\text{O}$, 1 mg/l $\text{NiCl}_2 \times 6 \text{H}_2\text{O}$, 3 mg/l $\text{Na}_2\text{MoO}_4 \times 2 \text{H}_2\text{O}$, 500 mg/l complexing agent
15 (EDTA or citric acid), 100 ml/l vitamins-mix (0.2 mg/l biotin, 0.2 mg/l folic acid, 20 mg/l p-amino benzoic acid, 20 mg/l riboflavin, 40 mg/l ca-panthothenate, 140 mg/l nicotinic acid, 40 mg/l pyridoxole hydrochloride, 200 mg/l myo-inositol). Lysozyme was added to the suspension to a final concentration of 2.5 mg/ml. After an approximately 4 h incubation at 37°C, the cell wall was degraded and the resulting
20 protoplasts are harvested by centrifugation. The pellet was washed once with 5 ml buffer-I and once with 5 ml TE-buffer (10 mM Tris-HCl, 1 mM EDTA, pH 8). The pellet was resuspended in 4 ml TE-buffer and 0.5 ml SDS solution (10%) and 0.5 ml NaCl solution (5 M) are added. After adding of proteinase K to a final concentration of 200 µg/ml, the suspension is incubated for ca.18 h at 37°C. The DNA was purified by
25 extraction with phenol, phenol-chloroform-isoamylalcohol and chloroform-isoamylalcohol using standard procedures. Then, the DNA was precipitated by adding 1/50 volume of 3 M sodium acetate and 2 volumes of ethanol, followed by a 30 min incubation at -20°C and a 30 min centrifugation at 12,000 rpm in a high speed centrifuge using a SS34 rotor (Sorvall). The DNA was dissolved in 1 ml TE-buffer containing 20
30 µg/ml RNaseA and dialysed at 4°C against 1000 ml TE-buffer for at least 3 hours. During this time, the buffer was exchanged 3 times. To aliquots of 0.4 ml of the dialysed DNA solution, 0.4 ml of 2 M LiCl and 0.8 ml of ethanol are added. After a 30

min incubation at -20°C, the DNA was collected by centrifugation (13,000 rpm, Biofuge Fresco, Heraeus, Hanau, Germany). The DNA pellet was dissolved in TE-buffer. DNA prepared by this procedure could be used for all purposes, including southern blotting or construction of genomic libraries.

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Example 2: Construction of genomic libraries in *Escherichia coli* of *Corynebacterium glutamicum* ATCC13032.

Using DNA prepared as described in Example 1, cosmid and plasmid libraries were constructed according to known and well established methods (*see e.g.*, Sambrook, J. *et al.* (1989) "Molecular Cloning : A Laboratory Manual", Cold Spring Harbor Laboratory Press, or Ausubel, F.M. *et al.* (1994) "Current Protocols in Molecular Biology", John Wiley & Sons.)

Any plasmid or cosmid could be used. Of particular use were the plasmids pBR322 (Sutcliffe, J.G. (1979) *Proc. Natl. Acad. Sci. USA*, 75:3737-3741); pACYC177 (Change & Cohen (1978) *J. Bacteriol* 134:1141-1156), plasmids of the pBS series (pBSSK+, pBSSK- and others; Stratagene, LaJolla, USA), or cosmids as SuperCos1 (Stratagene, LaJolla, USA) or Lorist6 (Gibson, T.J., Rosenthal A. and Waterson, R.H. (1987) *Gene* 53:283-286. Gene libraries specifically for use in *C. glutamicum* may be constructed using plasmid pSL109 (Lee, H.-S. and A. J. Sinskey (1994) *J. Microbiol. Biotechnol.* 4: 256-263).

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Example 3: DNA Sequencing and Computational Functional Analysis

Genomic libraries as described in Example 2 were used for DNA sequencing according to standard methods, in particular by the chain termination method using ABI377 sequencing machines (*see e.g.*, Fleischman, R.D. *et al.* (1995) "Whole-genome Random Sequencing and Assembly of Haemophilus Influenzae Rd., *Science*, 269:496-512). Sequencing primers with the following nucleotide sequences were used: 5'-GGAAACAGTATGACCATG-3' or 5'-GTAAAACGACGGCCAGT-3'.

Example 4: *In vivo* Mutagenesis

In vivo mutagenesis of *Corynebacterium glutamicum* can be performed by passage of plasmid (or other vector) DNA through *E. coli* or other microorganisms (*e.g.* *Bacillus* spp. or yeasts such as *Saccharomyces cerevisiae*) which are impaired in their capabilities to maintain

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the integrity of their genetic information. Typical mutator strains have mutations in the genes for the DNA repair system (*e.g.*, *mutHLS*, *mutD*, *mutT*, etc.; for reference, see Rupp, W.D. (1996) DNA repair mechanisms, in: *Escherichia coli* and *Salmonella*, p. 2277-2294, ASM: Washington.) Such strains are well known to those of ordinary skill in the art. The use of such strains is illustrated, for example, in Greener, A. and Callahan, M. (1994) *Strategies* 7: 32-34.

Example 5: DNA Transfer Between *Escherichia coli* and *Corynebacterium glutamicum*

Several *Corynebacterium* and *Brevibacterium* species contain endogenous plasmids (as *e.g.*, pHM1519 or pBL1) which replicate autonomously (for review see, *e.g.*, Martin, J.F. *et al.* (1987) *Biotechnology*, 5:137-146). Shuttle vectors for *Escherichia coli* and *Corynebacterium glutamicum* can be readily constructed by using standard vectors for *E. coli* (Sambrook, J. *et al.* (1989), "Molecular Cloning: A Laboratory Manual", Cold Spring Harbor Laboratory Press or Ausubel, F.M. *et al.* (1994) "Current Protocols in Molecular Biology", John Wiley & Sons) to which a origin or replication for and a suitable marker from *Corynebacterium glutamicum* is added. Such origins of replication are preferably taken from endogenous plasmids isolated from *Corynebacterium* and *Brevibacterium* species. Of particular use as transformation markers for these species are genes for kanamycin resistance (such as those derived from the Tn5 or Tn903 transposons) or chloramphenicol (Winnacker, E.L. (1987) "From Genes to Clones — Introduction to Gene Technology, VCH, Weinheim). There are numerous examples in the literature of the construction of a wide variety of shuttle vectors which replicate in both *E. coli* and *C. glutamicum*, and which can be used for several purposes, including gene over-expression (for reference, see *e.g.*, Yoshihama, M. *et al.* (1985) *J. Bacteriol.* 162:591-597, Martin J.F. *et al.* (1987) *Biotechnology*, 5:137-146 and Eikmanns, B.J. *et al.* (1991) *Gene*, 102:93-98).

Using standard methods, it is possible to clone a gene of interest into one of the shuttle vectors described above and to introduce such a hybrid vector into strains of *Corynebacterium glutamicum*. Transformation of *C. glutamicum* can be achieved by protoplast transformation (Kastsumata, R. *et al.* (1984) *J. Bacteriol.* 159:306-311), electroporation (Liebl, E. *et al.* (1989) *FEMS Microbiol. Letters*, 53:399-303) and in cases where special vectors are used, also by conjugation (as described *e.g.* in Schäfer, A *et al.*

(1990) *J. Bacteriol.* 172:1663-1666). It is also possible to transfer the shuttle vectors for *C. glutamicum* to *E. coli* by preparing plasmid DNA from *C. glutamicum* (using standard methods well-known in the art) and transforming it into *E. coli*. This transformation step can be performed using standard methods, but it is advantageous to use an *Mcr*-deficient
5 *E. coli* strain, such as NM522 (Gough & Murray (1983) *J. Mol. Biol.* 166:1-19).

Genes may be overexpressed in *C. glutamicum* strains using plasmids which comprise pCG1 (U.S. Patent No. 4,617,267) or fragments thereof, and optionally the gene for kanamycin resistance from TN903 (Grindley, N.D. and Joyce, C.M. (1980) *Proc. Natl. Acad. Sci. USA* 77(12): 7176-7180). In addition, genes may be
10 overexpressed in *C. glutamicum* strains using plasmid pSL109 (Lee, H.-S. and A. J. Sinskey (1994) *J. Microbiol. Biotechnol.* 4: 256-263).

Aside from the use of replicative plasmids, gene overexpression can also be achieved by integration into the genome. Genomic integration in *C. glutamicum* or other *Corynebacterium* or *Brevibacterium* species may be accomplished by well-known
15 methods, such as homologous recombination with genomic region(s), restriction endonuclease mediated integration (REMI) (see, *e.g.*, DE Patent 19823834), or through the use of transposons. It is also possible to modulate the activity of a gene of interest by modifying the regulatory regions (*e.g.*, a promoter, a repressor, and/or an enhancer) by sequence modification, insertion, or deletion using site-directed methods (such as
20 homologous recombination) or methods based on random events (such as transposon mutagenesis or REMI). Nucleic acid sequences which function as transcriptional terminators may also be inserted 3' to the coding region of one or more genes of the invention; such terminators are well-known in the art and are described, for example, in Winnacker, E.L. (1987) *From Genes to Clones – Introduction to Gene Technology*. VCH:
25 Weinheim.

Example 6: Assessment of the Expression of the Mutant Protein

Observations of the activity of a mutated protein in a transformed host cell rely on the fact that the mutant protein is expressed in a similar fashion and in a similar quantity
30 to that of the wild-type protein. A useful method to ascertain the level of transcription of the mutant gene (an indicator of the amount of mRNA available for translation to the gene product) is to perform a Northern blot (for reference see, for example, Ausubel *et al.*

(1988) Current Protocols in Molecular Biology, Wiley: New York), in which a primer designed to bind to the gene of interest is labeled with a detectable tag (usually radioactive or chemiluminescent), such that when the total RNA of a culture of the organism is extracted, run on gel, transferred to a stable matrix and incubated with this probe, the binding and quantity of binding of the probe indicates the presence and also the quantity of mRNA for this gene. This information is evidence of the degree of transcription of the mutant gene. Total cellular RNA can be prepared from *Corynebacterium glutamicum* by several methods, all well-known in the art, such as that described in Bormann, E.R. *et al.* (1992) *Mol. Microbiol.* 6: 317-326.

10 To assess the presence or relative quantity of protein translated from this mRNA, standard techniques, such as a Western blot, may be employed (see, for example, Ausubel *et al.* (1988) Current Protocols in Molecular Biology, Wiley: New York). In this process, total cellular proteins are extracted, separated by gel electrophoresis, transferred to a matrix such as nitrocellulose, and incubated with a probe, such as an antibody, which
15 specifically binds to the desired protein. This probe is generally tagged with a chemiluminescent or colorimetric label which may be readily detected. The presence and quantity of label observed indicates the presence and quantity of the desired mutant protein present in the cell.

20 **Example 7: Growth of Genetically Modified *Corynebacterium glutamicum* — Media and Culture Conditions**

Genetically modified *Corynebacteria* are cultured in synthetic or natural growth media. A number of different growth media for *Corynebacteria* are both well-known and readily available (Lieb *et al.* (1989) *Appl. Microbiol. Biotechnol.*, 32:205-210; von der
25 Osten *et al.* (1998) *Biotechnology Letters*, 11:11-16; Patent DE 4,120,867; Liebl (1992) "The Genus *Corynebacterium*, in: The Prokaryotes, Volume II, Balows, A. *et al.*, eds. Springer-Verlag). These media consist of one or more carbon sources, nitrogen sources, inorganic salts, vitamins and trace elements. Preferred carbon sources are sugars, such as mono-, di-, or polysaccharides. For example, glucose, fructose, mannose, galactose,
30 ribose, sorbose, ribulose, lactose, maltose, sucrose, raffinose, starch or cellulose serve as very good carbon sources. It is also possible to supply sugar to the media via complex compounds such as molasses or other by-products from sugar refinement. It can also be

advantageous to supply mixtures of different carbon sources. Other possible carbon sources are alcohols and organic acids, such as methanol, ethanol, acetic acid or lactic acid. Nitrogen sources are usually organic or inorganic nitrogen compounds, or materials which contain these compounds. Exemplary nitrogen sources include ammonia gas or
5 ammonia salts, such as NH_4Cl or $(\text{NH}_4)_2\text{SO}_4$, NH_4OH , nitrates, urea, amino acids or complex nitrogen sources like corn steep liquor, soy bean flour, soy bean protein, yeast extract, meat extract and others.

Inorganic salt compounds which may be included in the media include the chloride-, phosphorous- or sulfate- salts of calcium, magnesium, sodium, cobalt,
10 molybdenum, potassium, manganese, zinc, copper and iron. Chelating compounds can be added to the medium to keep the metal ions in solution. Particularly useful chelating compounds include dihydroxyphenols, like catechol or protocatechuate, or organic acids, such as citric acid. It is typical for the media to also contain other growth factors, such as vitamins or growth promoters, examples of which include biotin, riboflavin, thiamin, folic
15 acid, nicotinic acid, pantothenate and pyridoxin. Growth factors and salts frequently originate from complex media components such as yeast extract, molasses, corn steep liquor and others. The exact composition of the media compounds depends strongly on the immediate experiment and is individually decided for each specific case. Information about media optimization is available in the textbook "Applied Microbiol. Physiology, A
20 Practical Approach (*eds.* P.M. Rhodes, P.F. Stanbury, IRL Press (1997) pp. 53-73, ISBN 0 19 963577 3). It is also possible to select growth media from commercial suppliers, like standard 1 (Merck) or BHI (grain heart infusion, DIFCO) or others.

All medium components are sterilized, either by heat (20 minutes at 1.5 bar and 121°C) or by sterile filtration. The components can either be sterilized together or, if
25 necessary, separately. All media components can be present at the beginning of growth, or they can optionally be added continuously or batchwise.

Culture conditions are defined separately for each experiment. The temperature should be in a range between 15°C and 45°C. The temperature can be kept constant or can be altered during the experiment. The pH of the medium should be in the range of 5 to
30 8.5, preferably around 7.0, and can be maintained by the addition of buffers to the media. An exemplary buffer for this purpose is a potassium phosphate buffer. Synthetic buffers such as MOPS, HEPES, ACES and others can alternatively or simultaneously be used. It

is also possible to maintain a constant culture pH through the addition of NaOH or NH₄OH during growth. If complex medium components such as yeast extract are utilized, the necessity for additional buffers may be reduced, due to the fact that many complex compounds have high buffer capacities. If a fermentor is utilized for culturing the micro-organisms, the pH can also be controlled using gaseous ammonia.

The incubation time is usually in a range from several hours to several days. This time is selected in order to permit the maximal amount of product to accumulate in the broth. The disclosed growth experiments can be carried out in a variety of vessels, such as microtiter plates, glass tubes, glass flasks or glass or metal fermentors of different sizes.

For screening a large number of clones, the microorganisms should be cultured in microtiter plates, glass tubes or shake flasks, either with or without baffles. Preferably 100 ml shake flasks are used, filled with 10% (by volume) of the required growth medium. The flasks should be shaken on a rotary shaker (amplitude 25 mm) using a speed-range of 100 – 300 rpm. Evaporation losses can be diminished by the maintenance of a humid atmosphere; alternatively, a mathematical correction for evaporation losses should be performed.

If genetically modified clones are tested, an unmodified control clone or a control clone containing the basic plasmid without any insert should also be tested. The medium is inoculated to an OD₆₀₀ of 0.5 – 1.5 using cells grown on agar plates, such as CM plates (10 g/l glucose, 2.5 g/l NaCl, 2 g/l urea, 10 g/l polypeptone, 5 g/l yeast extract, 5 g/l meat extract, 22 g/l NaCl, 2 g/l urea, 10 g/l polypeptone, 5 g/l yeast extract, 5 g/l meat extract, 22 g/l agar, pH 6.8 with 2M NaOH) that had been incubated at 30°C. Inoculation of the media is accomplished by either introduction of a saline suspension of *C. glutamicum* cells from CM plates or addition of a liquid preculture of this bacterium.

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Example 8 – *In vitro* Analysis of the Function of Mutant Proteins

The determination of activities and kinetic parameters of enzymes is well established in the art. Experiments to determine the activity of any given altered enzyme must be tailored to the specific activity of the wild-type enzyme, which is well within the ability of one of ordinary skill in the art. Overviews about enzymes in general, as well as specific details concerning structure, kinetics, principles, methods, applications and examples for the determination of many enzyme activities may be

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found, for example, in the following references: Dixon, M., and Webb, E.C., (1979) Enzymes. Longmans: London; Fersht, (1985) Enzyme Structure and Mechanism. Freeman: New York; Walsh, (1979) Enzymatic Reaction Mechanisms. Freeman: San Francisco; Price, N.C., Stevens, L. (1982) Fundamentals of Enzymology. Oxford Univ. Press: Oxford; Boyer, P.D., ed. (1983) The Enzymes, 3rd ed. Academic Press: New York; Bisswanger, H., (1994) Enzymkinetik, 2nd ed. VCH: Weinheim (ISBN 3527300325); Bergmeyer, H.U., Bergmeyer, J., Graßl, M., eds. (1983-1986) Methods of Enzymatic Analysis, 3rd ed., vol. I-XII, Verlag Chemie: Weinheim; and Ullmann's Encyclopedia of Industrial Chemistry (1987) vol. A9, "Enzymes". VCH: Weinheim, p. 352-363.

The activity of proteins which bind to DNA can be measured by several well-established methods, such as DNA band-shift assays (also called gel retardation assays). The effect of such proteins on the expression of other molecules can be measured using reporter gene assays (such as that described in Kolmar, H. *et al.* (1995) *EMBO J.* 14: 3895-3904 and references cited therein). Reporter gene test systems are well known and established for applications in both pro- and eukaryotic cells, using enzymes such as beta-galactosidase, green fluorescent protein, and several others.

The determination of activity of membrane-transport proteins can be performed according to techniques such as those described in Gennis, R.B. (1989) "Pores, Channels and Transporters", in Biomembranes, Molecular Structure and Function, Springer: Heidelberg, p. 85-137; 199-234; and 270-322.

Example 9: Analysis of Impact of Mutant Protein on the Production of the Desired Product

The effect of the genetic modification in *C. glutamicum* on production of a desired compound (such as an amino acid) can be assessed by growing the modified microorganism under suitable conditions (such as those described above) and analyzing the medium and/or the cellular component for increased production of the desired product (*i.e.*, an amino acid). Such analysis techniques are well known to one of ordinary skill in the art, and include spectroscopy, thin layer chromatography, staining methods of various kinds, enzymatic and microbiological methods, and analytical chromatography such as high performance liquid chromatography (see, for example,

Ullman, Encyclopedia of Industrial Chemistry, vol. A2, p. 89-90 and p. 443-613, VCH: Weinheim (1985); Fallon, A. *et al.*, (1987) "Applications of HPLC in Biochemistry" in: Laboratory Techniques in Biochemistry and Molecular Biology, vol. 17; Rehm *et al.* (1993) Biotechnology, vol. 3, Chapter III: "Product recovery and purification", page 5 469-714, VCH: Weinheim; Belter, P.A. *et al.* (1988) Bioseparations: downstream processing for biotechnology, John Wiley and Sons; Kennedy, J.F. and Cabral, J.M.S. (1992) Recovery processes for biological materials, John Wiley and Sons; Shaeiwitz, J.A. and Henry, J.D. (1988) Biochemical separations, in: Ulmann's Encyclopedia of Industrial Chemistry, vol. B3, Chapter 11, page 1-27, VCH: Weinheim; and Dechow, 10 F.J. (1989) Separation and purification techniques in biotechnology, Noyes Publications.)

In addition to the measurement of the final product of fermentation, it is also possible to analyze other components of the metabolic pathways utilized for the production of the desired compound, such as intermediates and side-products, to 15 determine the overall yield, production, and/or efficiency of production of the compound. Analysis methods include measurements of nutrient levels in the medium (*e.g.*, sugars, hydrocarbons, nitrogen sources, phosphate, and other ions), measurements of biomass composition and growth, analysis of the production of common metabolites of biosynthetic pathways, and measurement of gasses produced during fermentation. 20 Standard methods for these measurements are outlined in Applied Microbial Physiology, A Practical Approach, P.M. Rhodes and P.F. Stanbury, eds., IRL Press, p. 103-129; 131-163; and 165-192 (ISBN: 0199635773) and references cited therein.

Example 10: Purification of the Desired Product from *C. glutamicum* Culture

25 Recovery of the desired product from the *C. glutamicum* cells or supernatant of the above-described culture can be performed by various methods well known in the art. If the desired product is not secreted from the cells, the cells can be harvested from the culture by low-speed centrifugation, the cells can be lysed by standard techniques, such as mechanical force or sonication. The cellular debris is removed by centrifugation, and 30 the supernatant fraction containing the soluble proteins is retained for further purification of the desired compound. If the product is secreted from the *C. glutamicum*

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cells, then the cells are removed from the culture by low-speed centrifugation, and the supernate fraction is retained for further purification.

The supernatant fraction from either purification method is subjected to chromatography with a suitable resin, in which the desired molecule is either retained on a chromatography resin while many of the impurities in the sample are not, or where the impurities are retained by the resin while the sample is not. Such chromatography steps may be repeated as necessary, using the same or different chromatography resins. One of ordinary skill in the art would be well-versed in the selection of appropriate chromatography resins and in their most efficacious application for a particular molecule to be purified. The purified product may be concentrated by filtration or ultrafiltration, and stored at a temperature at which the stability of the product is maximized.

There are a wide array of purification methods known to the art and the preceding method of purification is not meant to be limiting. Such purification techniques are described, for example, in Bailey, J.E. & Ollis, D.F. *Biochemical Engineering Fundamentals*, McGraw-Hill: New York (1986).

The identity and purity of the isolated compounds may be assessed by techniques standard in the art. These include high-performance liquid chromatography (HPLC), spectroscopic methods, staining methods, thin layer chromatography, NIRS, enzymatic assay, or microbiologically. Such analysis methods are reviewed in: Patek *et al.* (1994) *Appl. Environ. Microbiol.* 60: 133-140; Malakhova *et al.* (1996) *Biotekhnologiya* 11: 27-32; and Schmidt *et al.* (1998) *Bioprocess Engineer.* 19: 67-70. Ulmann's Encyclopedia of Industrial Chemistry, (1996) vol. A27, VCH: Weinheim, p. 89-90, p. 521-540, p. 540-547, p. 559-566, 575-581 and p. 581-587; Michal, G. (1999) *Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology*, John Wiley and Sons; Fallon, A. *et al.* (1987) *Applications of HPLC in Biochemistry in: Laboratory Techniques in Biochemistry and Molecular Biology*, vol. 17.

EXAMPLE 11: Cloning of a *Corynebacterium glutamicum* Gene Involved in Lincomycin Resistance Using a Reporter Gene Approach

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A. Identification of the Gene Encoding the LMRB Protein

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Plasmid pSL130 was constructed by ligation of the *aceB* promoter region (paceB) of *C. glutamicum* (Kim, H.J. *et al.* (1997) *J. Microbiol. Biotechnol.* 7: 287-292) into the polylinker of the lac operon fusion vector pRS415, which lacks a promoter (Simon, R.W. *et al.* (1987) *Gene* 53: 85-96). Plasmid pSL145 was constructed by
5 ligating the resulting paceB-lac region into the *E. coli* cloning vector pACYC184. *E. coli* DH5 α F' was transformed with pSL145 and the resulting strain was used as a host for screening of a genomic *C. glutamicum* library (in pSL109).

Transformants were screened by growth on agar medium containing 5-bromo-4-chloro-3-indolyl-beta-D-galactopyranoside (X-Gal). A white colony, containing DNA
10 influencing lacZ expression, was selected for further analysis. This clone was found to contain a 4 kB fragment from the gene library. Subclones were constructed in pSL109 and a subclone which retained the white phenotype on X-Gal plates was identified. This subclone was found to contain a 2.6 kB BamHI-XhoI fragment (plasmid pSL149-5). The fragment was sequenced and identified as a membrane protein-encoding gene
15 (LMRB gene).

The 1442 nucleotides of the coding sequence of the LMRB gene encode a polypeptide of 481 amino acid residues with a high percentage of hydrophobic amino acids. A Genbank search determined that the LMRB protein is 40% identical to the protein product of the *lmrB* gene from *Bacillus subtilis* (Genbank Accession AL009126,
20 TREMBL Accession P94422), as determined using a CLUSTAL W analysis (using standard parameters).

The LMRN protein contains a sequence pattern: 158-A-P-A-L-G-P-T-L-S-G-167 (SEQ ID NO:301), which resembles the known multi-drug-resistance-protein consensus motif G-X-X-X-G-P-X-X-G-G (SEQ ID NO:302) (Paulsen, I.T., and Skurray, R.A.
25 (1993) *Gene* 124: 1-11). Therefore, the LMRB protein was classified as a drug resistance protein.

B. In vivo Analysis of lmrB Function

The *lmrB* gene was overexpressed in *C. glutamicum* ASO19E12 (Kim, H.J. *et al.*
30 (1997) *J. Microbiol. Biotechnol.* 7: 287-292) using the plasmid pSL149-5, described above.

Disruption of the LMRB gene was accomplished by use of the vector pSL18-lmrB. This vector was constructed as follows: an internal fragment of the LMRB gene was amplified by PCR under standard conditions using primers 5'-CTCCAGGATTGCTCCGAAGG-3' (SEQ ID NO:303) and 5'-CACAGTGGTTGACCACTGGC-3' (SEQ ID NO:304). The resulting PCR product was treated with T7 DNA polymerase and T7 polynucleotide kinase, and was cloned into the SmaI site of plasmid pSL18 (Kim, Y.H. and H.-S. Lee (1996) *J. Microbiol. Biotechnol.* 6: 315-320). The disruption of the LMRB gene in *C. glutamicum* ASO19E12 was performed by conjugation, as previously described (Schwarzer and Puhler (1991) *Bio/Technology* 9:84-87).

C. glutamicum cells transformed with pSL149-5 displayed similar resistances as untransformed cells against erythromycin, penicillin G, tetracycline, chloramphenicol, spectinomycin, nalidixic acid, gentamycin, streptomycin, ethidium bromide, carbonyl cyanide m-chlorophenylhydrazone (CCCP), and sodium dodecyl sulfate. Significant differences were observed, however, in the resistance of transformed and untransformed cells to lincomycin.

LMRB-overexpressing *C. glutamicum* cells were found to be able to grow in the presence of 20 µg/ml lincomycin. In contrast, cells which do not overexpress LMRB (or cells carrying a LMRB disruption) were not able to grow on agar media containing 5 µg/ml lincomycin. This effect was clearly visible in liquid culture. LMRB overexpression led to a 9-fold increased resistance (compared to wild-type) against lincomycin and LMRB disruption resulted in a decreased resistance (28% of wild-type) to this antibiotic.

Example 12: Analysis of the Gene Sequences of the Invention

The comparison of sequences and determination of percent homology between two sequences are art-known techniques, and can be accomplished using a mathematical algorithm, such as the algorithm of Karlin and Altschul (1990) *Proc. Natl. Acad. Sci. USA* 87:2264-68, modified as in Karlin and Altschul (1993) *Proc. Natl. Acad. Sci. USA* 90:5873-77. Such an algorithm is incorporated into the NBLAST and XBLAST programs (version 2.0) of Altschul, *et al.* (1990) *J. Mol. Biol.* 215:403-10. BLAST nucleotide searches can be performed with the NBLAST program, score = 100,

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wordlength = 12 to obtain nucleotide sequences homologous to SRT nucleic acid molecules of the invention. BLAST protein searches can be performed with the XBLAST program, score = 50, wordlength = 3 to obtain amino acid sequences homologous to SRT protein molecules of the invention. To obtain gapped alignments
5 for comparison purposes, Gapped BLAST can be utilized as described in Altschul *et al.*, (1997) *Nucleic Acids Res.* 25(17):3389-3402. When utilizing BLAST and Gapped BLAST programs, one of ordinary skill in the art will know how to optimize the parameters of the program (*e.g.*, XBLAST and NBLAST) for the specific sequence being analyzed.

10 Another example of a mathematical algorithm utilized for the comparison of sequences is the algorithm of Meyers and Miller ((1988) *Comput. Appl. Biosci.* 4: 11-17). Such an algorithm is incorporated into the ALIGN program (version 2.0) which is part of the GCG sequence alignment software package. When utilizing the ALIGN program for comparing amino acid sequences, a PAM120 weight residue table, a gap
15 length penalty of 12, and a gap penalty of 4 can be used. Additional algorithms for sequence analysis are known in the art, and include ADVANCE and ADAM. described in Torelli and Robotti (1994) *Comput. Appl. Biosci.* 10:3-5; and FASTA, described in Pearson and Lipman (1988) *P.N.A.S.* 85:2444-8.

The percent homology between two amino acid sequences can also be
20 accomplished using the GAP program in the GCG software package (available at <http://www.gcg.com>), using either a Blosum 62 matrix or a PAM250 matrix, and a gap weight of 12, 10, 8, 6, or 4 and a length weight of 2, 3, or 4. The percent homology between two nucleic acid sequences can be accomplished using the GAP program in the GCG software package, using standard parameters, such as a gap weight of 50 and a
25 length weight of 3.

A comparative analysis of the gene sequences of the invention with those present in Genbank has been performed using techniques known in the art (see, *e.g.*, Bexevanis and Ouellette, eds. (1998) *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.* John Wiley and Sons: New York). The gene sequences of the invention
30 were compared to genes present in Genbank in a three-step process. In a first step, a BLASTN analysis (*e.g.*, a local alignment analysis) was performed for each of the sequences of the invention against the nucleotide sequences present in Genbank, and the

top 500 hits were retained for further analysis. A subsequent FASTA search (*e.g.*, a combined local and global alignment analysis, in which limited regions of the sequences are aligned) was performed on these 500 hits. Each gene sequence of the invention was subsequently globally aligned to each of the top three FASTA hits, using the GAP
5 program in the GCG software package (using standard parameters). In order to obtain correct results, the length of the sequences extracted from Genbank were adjusted to the length of the query sequences by methods well-known in the art. The results of this analysis are set forth in Table 4. The resulting data is identical to that which would have been obtained had a GAP (global) analysis alone been performed on each of the genes of
10 the invention in comparison with each of the references in Genbank, but required significantly reduced computational time as compared to such a database-wide GAP (global) analysis. Sequences of the invention for which no alignments above the cutoff values were obtained are indicated on Table 4 by the absence of alignment information. It will further be understood by one of ordinary skill in the art that the GAP alignment
15 homology percentages set forth in Table 4 under the heading "% homology (GAP)" are listed in the European numerical format, wherein a ',' represents a decimal point. For example, a value of "40,345" in this column represents "40.345%".

Example 13: Construction and Operation of DNA Microarrays

20 The sequences of the invention may additionally be used in the construction and application of DNA microarrays (the design, methodology, and uses of DNA arrays are well known in the art, and are described, for example, in Schena, M. *et al.* (1995) *Science* 270: 467-470; Wodicka, L. *et al.* (1997) *Nature Biotechnology* 15: 1359-1367; DeSaizieu, A. *et al.* (1998) *Nature Biotechnology* 16: 45-48; and DeRisi, J.L. *et al.*
25 (1997) *Science* 278: 680-686).

DNA microarrays are solid or flexible supports consisting of nitrocellulose, nylon, glass, silicone, or other materials. Nucleic acid molecules may be attached to the surface in an ordered manner. After appropriate labeling, other nucleic acids or nucleic acid mixtures can be hybridized to the immobilized nucleic acid molecules, and the label
30 may be used to monitor and measure the individual signal intensities of the hybridized molecules at defined regions. This methodology allows the simultaneous quantification of the relative or absolute amount of all or selected nucleic acids in the applied nucleic

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acid sample or mixture. DNA microarrays, therefore, permit an analysis of the expression of multiple (as many as 6800 or more) nucleic acids in parallel (see, *e.g.*, Schena, M. (1996) *BioEssays* 18(5): 427-431).

The sequences of the invention may be used to design oligonucleotide primers
5 which are able to amplify defined regions of one or more *C. glutamicum* genes by a nucleic acid amplification reaction such as the polymerase chain reaction. The choice and design of the 5' or 3' oligonucleotide primers or of appropriate linkers allows the covalent attachment of the resulting PCR products to the surface of a support medium described above (and also described, for example, Schena, M. *et al.* (1995) *Science* 270:
10 467-470).

Nucleic acid microarrays may also be constructed by *in situ* oligonucleotide synthesis as described by Wodicka, L. *et al.* (1997) *Nature Biotechnology* 15: 1359-1367. By photolithographic methods, precisely defined regions of the matrix are exposed to light. Protective groups which are photolabile are thereby activated and
15 undergo nucleotide addition, whereas regions that are masked from light do not undergo any modification. Subsequent cycles of protection and light activation permit the synthesis of different oligonucleotides at defined positions. Small, defined regions of the genes of the invention may be synthesized on microarrays by solid phase oligonucleotide synthesis.

20 The nucleic acid molecules of the invention present in a sample or mixture of nucleotides may be hybridized to the microarrays. These nucleic acid molecules can be labeled according to standard methods. In brief, nucleic acid molecules (*e.g.*, mRNA molecules or DNA molecules) are labeled by the incorporation of isotopically or fluorescently labeled nucleotides, *e.g.*, during reverse transcription or DNA synthesis.
25 Hybridization of labeled nucleic acids to microarrays is described (*e.g.*, in Schena, M. *et al.* (1995) *supra*; Wodicka, L. *et al.* (1997), *supra*; and DeSaizieu A. *et al.* (1998), *supra*). The detection and quantification of the hybridized molecule are tailored to the specific incorporated label. Radioactive labels can be detected, for example, as described in Schena, M. *et al.* (1995) *supra*) and fluorescent labels may be detected, for
30 example, by the method of Shalon *et al.* (1996) *Genome Research* 6: 639-645).

The application of the sequences of the invention to DNA microarray technology, as described above, permits comparative analyses of different strains of *C.*

glutamicum or other Corynebacteria. For example, studies of inter-strain variations based on individual transcript profiles and the identification of genes that are important for specific and/or desired strain properties such as pathogenicity, productivity and stress tolerance are facilitated by nucleic acid array methodologies. Also, comparisons
5 of the profile of expression of genes of the invention during the course of a fermentation reaction are possible using nucleic acid array technology.

**Example 14: Analysis of the Dynamics of Cellular Protein Populations
(Proteomics)**

10 The genes, compositions, and methods of the invention may be applied to study the interactions and dynamics of populations of proteins, termed 'proteomics'. Protein populations of interest include, but are not limited to, the total protein population of *C. glutamicum* (*e.g.*, in comparison with the protein populations of other organisms), those proteins which are active under specific environmental or metabolic conditions (*e.g.*,
15 during fermentation, at high or low temperature, or at high or low pH), or those proteins which are active during specific phases of growth and development.

Protein populations can be analyzed by various well-known techniques, such as gel electrophoresis. Cellular proteins may be obtained, for example, by lysis or extraction, and may be separated from one another using a variety of electrophoretic
20 techniques. Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) separates proteins largely on the basis of their molecular weight. Isoelectric focusing polyacrylamide gel electrophoresis (IEF-PAGE) separates proteins by their isoelectric point (which reflects not only the amino acid sequence but also posttranslational modifications of the protein). Another, more preferred method of protein analysis is the
25 consecutive combination of both IEF-PAGE and SDS-PAGE, known as 2-D-gel electrophoresis (described, for example, in Hermann *et al.* (1998) *Electrophoresis* 19: 3217-3221; Fountoulakis *et al.* (1998) *Electrophoresis* 19: 1193-1202; Langen *et al.* (1997) *Electrophoresis* 18: 1184-1192; Antelmann *et al.* (1997) *Electrophoresis* 18: 1451-1463). Other separation techniques may also be utilized for protein separation,
30 such as capillary gel electrophoresis; such techniques are well known in the art.

Proteins separated by these methodologies can be visualized by standard techniques, such as by staining or labeling. Suitable stains are known in the art, and

include Coomassie Brilliant Blue, silver stain, or fluorescent dyes such as Sypro Ruby (Molecular Probes). The inclusion of radioactively labeled amino acids or other protein precursors (*e.g.*, ^{35}S -methionine, ^{35}S -cysteine, ^{14}C -labelled amino acids, ^{15}N -amino acids, $^{15}\text{NO}_3$ or $^{15}\text{NH}_4^+$ or ^{13}C -labelled amino acids) in the medium of *C. glutamicum* permits the labeling of proteins from these cells prior to their separation. Similarly, fluorescent labels may be employed. These labeled proteins can be extracted, isolated and separated according to the previously described techniques.

Proteins visualized by these techniques can be further analyzed by measuring the amount of dye or label used. The amount of a given protein can be determined quantitatively using, for example, optical methods and can be compared to the amount of other proteins in the same gel or in other gels. Comparisons of proteins on gels can be made, for example, by optical comparison, by spectroscopy, by image scanning and analysis of gels, or through the use of photographic films and screens. Such techniques are well-known in the art.

To determine the identity of any given protein, direct sequencing or other standard techniques may be employed. For example, N- and/or C-terminal amino acid sequencing (such as Edman degradation) may be used, as may mass spectrometry (in particular MALDI or ESI techniques (see, *e.g.*, Langen *et al.* (1997) *Electrophoresis* 18: 1184-1192)). The protein sequences provided herein can be used for the identification of *C. glutamicum* proteins by these techniques.

The information obtained by these methods can be used to compare patterns of protein presence, activity, or modification between different samples from various biological conditions (*e.g.*, different organisms, time points of fermentation, media conditions, or different biotopes, among others). Data obtained from such experiments alone, or in combination with other techniques, can be used for various applications, such as to compare the behavior of various organisms in a given (*e.g.*, metabolic) situation, to increase the productivity of strains which produce fine chemicals or to increase the efficiency of the production of fine chemicals.

Equivalents

Those of ordinary skill in the art will recognize, or will be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments of the invention described herein. Such equivalents are intended to be encompassed by the

5 following claims.

What is claimed:

1. An isolated nucleic acid molecule from *Corynebacterium glutamicum* encoding a stress, resistance, or tolerance gene, or a portion thereof, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
2. The isolated nucleic acid molecule of claim 1, wherein said stress, resistance, or tolerance gene is selected from the group consisting of nucleic acid molecules involved in a stress response, tolerance, or resistance to temperature stresses, pH stresses, oxygen stresses, osmotic stresses, toxic chemicals, oxygen radicals, antibiotics, or to lincomycin.
3. An isolated *Corynebacterium glutamicum* nucleic acid molecule selected from the group consisting of those sequences set forth as odd-numbered SEQ ID NOs of the Sequence Listing, or a portion thereof, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
4. An isolated nucleic acid molecule which encodes a polypeptide sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
5. An isolated nucleic acid molecule which encodes a naturally occurring allelic variant of a polypeptide selected from the group of amino acid sequences consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
6. An isolated nucleic acid molecule comprising a nucleotide sequence which is at least 50% homologous to a nucleotide sequence selected from the group consisting of those sequences set forth as odd-numbered SEQ ID NOs of the Sequence Listing, or

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a portion thereof, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.

7. An isolated nucleic acid molecule comprising a fragment of at least 15 nucleotides
5 of a nucleic acid comprising a nucleotide sequence selected from the group consisting of those sequences set forth as odd-numbered SEQ ID NOs of the Sequence Listing, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
- 10 8. An isolated nucleic acid molecule which hybridizes to the nucleic acid molecule of any one of claims 1-7 under stringent conditions.
9. An isolated nucleic acid molecule comprising the nucleic acid molecule of any one of claims 1-8 or a portion thereof and a nucleotide sequence encoding a heterologous
15 polypeptide.
10. A vector comprising the nucleic acid molecule of any one of claims 1-9.
11. The vector of claim 10, which is an expression vector.
- 20 12. A host cell transfected with the expression vector of claim 11.
13. The host cell of claim 12, wherein said cell is a microorganism.
- 25 14. The host cell of claim 13, wherein said cell belongs to the genus *Corynebacterium* or *Brevibacterium*.
15. The host cell of claim 12, wherein the expression of said nucleic acid molecule results in the modulation in production of a fine chemical from said cell.
- 30 16. The host cell of claim 15, wherein said fine chemical is selected from the group consisting of: organic acids, proteinogenic and nonproteinogenic amino acids, purine

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and pyrimidine bases, nucleosides, nucleotides, lipids, saturated and unsaturated fatty acids, diols, carbohydrates, aromatic compounds, vitamins, cofactors, polyketides, and enzymes.

5 17. A method of producing a polypeptide comprising culturing the host cell of claim 12 in an appropriate culture medium to, thereby, produce the polypeptide.

18. An isolated stress, resistance, or tolerance polypeptide from *Corynebacterium glutamicum*, or a portion thereof.

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19. The protein of claim 18, wherein said stress, resistance, or tolerance polypeptide is selected from the group consisting of proteins involved in a stress response, tolerance, or resistance to temperature stresses, pH stresses, oxygen stresses, osmotic stresses, toxic chemicals, oxygen radicals, antibiotics, or to lincomycin.

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20. An isolated polypeptide comprising an amino acid sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the amino acid sequence is not encoded by any of the F-designated genes set forth in Table 1.

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21. An isolated polypeptide comprising a naturally occurring allelic variant of a polypeptide comprising an amino acid sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, or a portion thereof, provided that the amino acid sequence is not encoded
25 by any of the F-designated genes set forth in Table 1.

22. The isolated polypeptide of any of claims 18-21, further comprising heterologous amino acid sequences.

30 23. An isolated polypeptide which is encoded by a nucleic acid molecule comprising a nucleotide sequence which is at least 50% homologous to a nucleic acid selected from the group consisting of those sequences set forth as odd-numbered SEQ ID

NOs of the Sequence Listing,, provided that the nucleic acid molecule does not consist of any of the F-designated nucleic acid molecules set forth in Table 1.

24. An isolated polypeptide comprising an amino acid sequence which is at least 50% homologous to an amino acid sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the amino acid sequence is not encoded by any of the F-designated genes set forth in Table 1.
25. A method for producing a fine chemical, comprising culturing a cell containing a vector of claim 12 such that the fine chemical is produced.
26. The method of claim 25, wherein said method further comprises the step of recovering the fine chemical from said culture.
27. The method of claim 25, wherein said method further comprises the step of transfecting said cell with the vector of claim 11 to result in a cell containing said vector.
28. The method of claim 25, wherein said cell belongs to the genus *Corynebacterium* or *Brevibacterium*.
29. The method of claim 25, wherein said cell is selected from the group consisting of: *Corynebacterium glutamicum*, *Corynebacterium herculis*, *Corynebacterium lilium*, *Corynebacterium acetoacidophilum*, *Corynebacterium acetoglutamicum*, *Corynebacterium acetophilum*, *Corynebacterium ammoniagenes*, *Corynebacterium fujiokense*, *Corynebacterium nitrilophilus*, *Brevibacterium ammoniagenes*, *Brevibacterium butanicum*, *Brevibacterium divaricatum*, *Brevibacterium flavum*, *Brevibacterium healii*, *Brevibacterium ketoglutamicum*, *Brevibacterium ketosoreductum*, *Brevibacterium lactofermentum*, *Brevibacterium linens*, *Brevibacterium paraffinolyticum*, and those strains set forth in Table 3.

30. The method of claim 25, wherein expression of the nucleic acid molecule from said vector results in modulation of production of said fine chemical.
31. The method of claim 25, wherein said fine chemical is selected from the group
5 consisting of: organic acids, proteinogenic and nonproteinogenic amino acids, purine and pyrimidine bases, nucleosides, nucleotides, lipids, saturated and unsaturated fatty acids, diols, carbohydrates, aromatic compounds, vitamins, cofactors, polyketides and enzymes.
- 10 32. The method of claim 25, wherein said fine chemical is an amino acid.
33. The method of claim 32, wherein said amino acid is drawn from the group consisting of: lysine, glutamate, glutamine, alanine, aspartate, glycine, serine, threonine, methionine, cysteine, valine, leucine, isoleucine, arginine, proline, histidine,
15 tyrosine, phenylalanine, and tryptophan.
34. A method for producing a fine chemical, comprising culturing a cell whose genomic DNA has been altered by the inclusion of a nucleic acid molecule of any one of claims 1-9.
20
35. A method for diagnosing the presence or activity of *Corynebacterium diphtheriae* in a subject, comprising detecting the presence of one or more SEQ ID NOs 1 through 304 of the Sequence Listing in the subject, provided that the sequences are not or are not encoded by any of the F-designated sequences set forth in Table 1, thereby
25 diagnosing the presence or activity of *Corynebacterium diphtheriae* in the subject.
36. A host cell comprising a nucleic acid molecule selected from the group consisting of the nucleic acid molecules set forth as odd-numbered SEQ ID NOs of the Sequence Listing, wherein the nucleic acid molecule is disrupted.
30
37. A host cell comprising a nucleic acid molecule selected from the group consisting of the nucleic acid molecules set forth as odd-numbered SEQ ID NOs of the

Sequence Listing , wherein the nucleic acid molecule comprises one or more nucleic acid modifications from the sequence set forth as odd-numbered SEQ ID NOs of the Sequence Listing .

- 5 38. A host cell comprising a nucleic acid molecule selected from the group consisting of the nucleic acid molecules set as odd-numbered SEQ ID NOs of the Sequence Listing, wherein the regulatory region of the nucleic acid molecule is modified relative to the wild-type regulatory region of the molecule.

SEQUENCE LISTING

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Asn Thr Gln Thr Ser Pro Ala Ala Ala Lys Leu Pro Arg Glu Val Val
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Val Val Leu Ser Ile Leu Val Val Ser Ala Met Ile Met Ile Leu Asn
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Glu Thr Ile Leu Ser Val Ala Leu Pro Ser Ile Met Glu Asp Phe Ser
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Val Pro Glu Thr Thr Ala Gln Trp Leu Thr Thr Gly Phe Met Leu Thr
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Met Ala Val Val Ile Pro Thr Thr Gly Tyr Leu Leu Asp Arg Phe Ser
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Thr Lys Thr Ile Phe Val Thr Ala Leu Leu Phe Phe Thr Val Gly Thr
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Leu Thr Ala Ala Leu Ala Pro Thr Phe Ala Val Leu Leu Gly Ala Arg
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| atc ctt tcg gtg ttt gcc ttc ggt ggt ttg gtg tac ggc ttc agt tcc Ile Leu Ser Val Phe Ala Phe Gly Gly Leu Val Tyr Gly Phe Ser Ser 215 220 225 | | | 787 |
| ttc gga gca atc ctg gag ggc gaa ggc acc gta ggt atc ttc gcg atc Phe Gly Ala Ile Leu Glu Gly Glu Gly Thr Val Gly Ile Phe Ala Ile 230 235 240 245 | | | 835 |
| gtc gtt ggc gcc atc gca ctc ctc atc ttt gct ttg cga cag cac caa Val Val Gly Ala Ile Ala Leu Leu Ile Phe Ala Leu Arg Gln His Gln 250 255 260 | | | 883 |
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cac ggc tcc gca att ttg aac acg ttc caa cag ctc gca ggc gca gcc 1363
 His Gly Ser Ala Ile Leu Asn Thr Phe Gln Gln Leu Ala Gly Ala Ala
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 Trp Leu Phe Trp Met Met Leu Pro Ile Val Val Ile Ala Leu Val Ile
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 Asp Val Leu Ser Val Ile Leu Ser Val Phe Ala Phe Gly Gly Leu Val
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| Arg Lys Leu Arg Val Glu Asp Ala Ile Asn Ala Ala Arg Ala Ala Ala | |
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| Leu | Gln | Thr | Leu | Val | Val | Asn | Ser | Ile | Arg | Lys | Thr | Ile | Lys | Val | Val | | | | |
| | | | 260 | | | | | 265 | | | | | 270 | | | | | | |
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| | | 275 | | | | | 280 | | | | | 285 | | | | | | | |
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| | 290 | | | | | 295 | | | | | 300 | | | | | | | | |
| Ile | Asn | Leu | Asn | Glu | Ala | Gly | Glu | Glu | Val | Phe | Gly | Thr | Ala | Arg | Arg | | | | |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 | | | | |
| Ile | Thr | Val | Ser | Lys | Asp | Glu | Thr | Ile | Ile | Val | Asp | Gly | Ala | Gly | Ser | | | | |
| | | | | 325 | | | | | 330 | | | | | 335 | | | | | |
| Ala | Glu | Asp | Val | Glu | Ala | Arg | Arg | Gly | Gln | Ile | Arg | Arg | Glu | Ile | Ala | | | | |
| | | | 340 | | | | | 345 | | | | | 350 | | | | | | |
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| Ala | Arg | Ala | Ala | Ala | Gln | Glu | Gly | Val | Ile | Ala | Gly | Gly | Gly | Ser | Ala | | | | |
| | | | | 405 | | | | | 410 | | | | | 415 | | | | | |
| Leu | Val | Gln | Ile | Ala | Glu | Thr | Leu | Lys | Ala | Tyr | Ala | Glu | Glu | Phe | Glu | | | | |
| | | | 420 | | | | | 425 | | | | | 430 | | | | | | |
| Gly | Asp | Gln | Lys | Val | Gly | Val | Arg | Ala | Leu | Ala | Thr | Ala | Leu | Gly | Lys | | | | |
| | | 435 | | | | | 440 | | | | | 445 | | | | | | | |
| Pro | Ala | Tyr | Trp | Ile | Ala | Ser | Asn | Ala | Gly | Leu | Asp | Gly | Ser | Val | Val | | | | |
| | 450 | | | | | 455 | | | | | 460 | | | | | | | | |
| Val | Ala | Arg | Thr | Ala | Ala | Leu | Pro | Asn | Gly | Glu | Gly | Phe | Asn | Ala | Ala | | | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| 465 | 470 | | | | | | | | 475 | | | | 480 | | | |
| Thr | Leu | Glu | Tyr | Gly | Asn | Leu | Ile | Asn | Asp | Gly | Val | Ile | Asp | Pro | Val | |
| | | | | 485 | | | | | 490 | | | | | 495 | | |
| Lys | Val | Thr | His | Ser | Ala | Val | Val | Asn | Ala | Thr | Ser | Val | Ala | Arg | Met | |
| | | | 500 | | | | | 505 | | | | | 510 | | | |
| Val | Leu | Thr | Thr | Glu | Ala | Ser | Val | Val | Glu | Lys | Pro | Ala | Glu | Glu | Ala | |
| | | 515 | | | | | 520 | | | | | 525 | | | | |
| Ala | Asp | Ala | His | Ala | Gly | His | His | His | His | | | | | | | |
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<223> FRXA00498
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| gtgacatcct | cgcaatcgtc | gagaagtagg | ggataagttc | atg | gca | aag | ctc | att | 115 | | | | | | | |
| | | | | Met | Ala | Lys | Leu | Ile | | | | | | | | |
| | | | | 1 | | | | 5 | | | | | | | | |
| gct | ttt | gac | cag | gac | gcc | cgc | gaa | ggc | att | ctc | cgg | ggc | gtt | gac | gct | 163 |
| Ala | Phe | Asp | Gln | Asp | Ala | Arg | Glu | Gly | Ile | Leu | Arg | Gly | Val | Asp | Ala | |
| | | | 10 | | | | | | 15 | | | | | 20 | | |
| ctg | gca | aac | gct | gtc | aag | gta | acc | ctc | ggc | cca | cgc | ggc | cgt | aac | gtg | 211 |
| Leu | Ala | Asn | Ala | Val | Lys | Val | Thr | Leu | Gly | Pro | Arg | Gly | Arg | Asn | Val | |
| | | | 25 | | | | | 30 | | | | | 35 | | | |
| gtt | ctt | gat | aag | gca | ttc | ggc | gga | cct | ctg | gtc | acc | aac | gac | ggt | gtc | 259 |
| Val | Leu | Asp | Lys | Ala | Phe | Gly | Gly | Pro | Leu | Val | Thr | Asn | Asp | Gly | Val | |
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| acc | att | gcc | cgc | gac | atc | gac | ctt | gag | gat | cct | ttt | gag | aac | ctc | ggt | 307 |
| Thr | Ile | Ala | Arg | Asp | Ile | Asp | Leu | Glu | Asp | Pro | Phe | Glu | Asn | Leu | Gly | |
| | 55 | | | | | 60 | | | | | 65 | | | | | |
| gcg | cag | ctg | gtg | aag | tcc | gtt | gct | gtt | aag | acc | aac | gac | atc | gct | ggt | 355 |
| Ala | Gln | Leu | Val | Lys | Ser | Val | Ala | Val | Lys | Thr | Asn | Asp | Ile | Ala | Gly | |
| 70 | | | | | 75 | | | | | 80 | | | | | 85 | |
| gac | ggc | acc | acg | act | gca | act | ctg | ctt | gct | cag | gca | ctc | att | gct | gaa | 403 |
| Asp | Gly | Thr | Thr | Thr | Ala | Thr | Leu | Leu | Ala | Gln | Ala | Leu | Ile | Ala | Glu | |
| | | | | 90 | | | | | 95 | | | | | 100 | | |
| ggc | ctg | cgc | aac | gtt | gct | gct | ggc | gca | aac | cca | atg | gag | ctc | aac | aag | 451 |

| | | | | | | | | | | | | | | | | | |
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| Gly | Leu | Arg | Asn | Val | Ala | Ala | Gly | Ala | Asn | Pro | Met | Glu | Leu | Asn | Lys | | |
| | | | 105 | | | | | 110 | | | | | 115 | | | | |
| ggt | att | tct | gca | gct | gca | gaa | aag | acc | ttg | gaa | gag | ttg | aag | gca | cgc | 499 | |
| Gly | Ile | Ser | Ala | Ala | Ala | Glu | Lys | Thr | Leu | Glu | Glu | Leu | Lys | Ala | Arg | | |
| | | 120 | | | | | 125 | | | | | 130 | | | | | |
| gca | acc | gag | gtg | tct | gac | acc | aag | gaa | atc | gca | aac | gtc | gct | acc | gtt | 547 | |
| Ala | Thr | Glu | Val | Ser | Asp | Thr | Lys | Glu | Ile | Ala | Asn | Val | Ala | Thr | Val | | |
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| tca | tcc | cgc | gat | gaa | gtt | gtc | ggc | gag | atc | gtt | gct | gca | gcg | atg | gaa | 595 | |
| Ser | Ser | Arg | Asp | Glu | Val | Val | Gly | Glu | Ile | Val | Ala | Ala | Ala | Met | Glu | | |
| 150 | | | | | 155 | | | | 160 | | | | | | 165 | | |
| aag | gtt | ggc | aag | gac | ggg | gtc | gtc | acc | gtt | gag | gag | tcc | cag | tcc | atc | 643 | |
| Lys | Val | Gly | Lys | Asp | Gly | Val | Val | Thr | Val | Glu | Glu | Ser | Gln | Ser | Ile | | |
| | | | 170 | | | | | 175 | | | | | 180 | | | | |
| gag | act | gct | ctc | gag | gtc | acc | gaa | ggg | att | tct | ttc | gac | aag | ggc | tac | 691 | |
| Glu | Thr | Ala | Leu | Glu | Val | Thr | Glu | Gly | Ile | Ser | Phe | Asp | Lys | Gly | Tyr | | |
| | | 185 | | | | | 190 | | | | | 195 | | | | | |
| ctt | tcc | cct | tat | ttc | atc | aac | gac | aac | gac | act | cag | cag | gct | gtc | ctg | 739 | |
| Leu | Ser | Pro | Tyr | Phe | Ile | Asn | Asp | Asn | Asp | Thr | Gln | Gln | Ala | Val | Leu | | |
| | | 200 | | | | | 205 | | | | | 210 | | | | | |
| gac | aac | cct | gca | gtg | ctg | ctt | gtt | cgc | aac | aag | att | tct | tcc | ctc | cca | 787 | |
| Asp | Asn | Pro | Ala | Val | Leu | Leu | Val | Arg | Asn | Lys | Ile | Ser | Ser | Leu | Pro | | |
| | 215 | | | | | 220 | | | | 225 | | | | | | | |
| gac | ttc | ctc | cca | ttg | ctg | gag | aag | gtt | gtg | gag | tcc | aac | cgt | cct | ttg | 835 | |
| Asp | Phe | Leu | Pro | Leu | Leu | Glu | Lys | Val | Val | Glu | Ser | Asn | Arg | Pro | Leu | | |
| 230 | | | | | 235 | | | | 240 | | | | | 245 | | | |
| ctg | atc | atc | gca | gaa | gac | gtc | gag | ggc | gag | cct | ttg | cag | acc | ctg | gtt | 883 | |
| Leu | Ile | Ile | Ala | Glu | Asp | Val | Glu | Gly | Glu | Pro | Leu | Gln | Thr | Leu | Val | | |
| | | | 250 | | | | 255 | | | | | | | 260 | | | |
| gtg | aac | tcc | atc | cgc | aag | acc | atc | aag | gtc | gtt | gca | gtg | aag | tcc | cct | 931 | |
| Val | Asn | Ser | Ile | Arg | Lys | Thr | Ile | Lys | Val | Val | Ala | Val | Lys | Ser | Pro | | |
| | | 265 | | | | | 270 | | | | | 275 | | | | | |
| tac | ttc | ggg | gac | cga | cgc | aag | gcg | ttc | atg | gat | gac | ctg | gct | att | gtc | 979 | |
| Tyr | Phe | Gly | Asp | Arg | Arg | Lys | Ala | Phe | Met | Asp | Asp | Leu | Ala | Ile | Val | | |
| | | 280 | | | | | 285 | | | | | 290 | | | | | |
| acc | aag | gca | act | gtc | gtg | gat | cca | gaa | gtg | ggc | atc | aac | ctc | aac | gaa | 1027 | |
| Thr | Lys | Ala | Thr | Val | Val | Asp | Pro | Glu | Val | Gly | Ile | Asn | Leu | Asn | Glu | | |
| | 295 | | | | | 300 | | | | 305 | | | | | | | |
| gct | ggc | gaa | gaa | gtt | ttc | ggg | acc | gca | cgc | cgc | atc | acc | gtt | tcc | aag | 1075 | |
| Ala | Gly | Glu | Glu | Val | Phe | Gly | Thr | Ala | Arg | Arg | Ile | Thr | Val | Ser | Lys | | |
| 310 | | | | | 315 | | | | 320 | | | | | 325 | | | |
| gac | gaa | acc | atc | atc | gtt | gat | ggg | gca | ggg | tcc | gca | gaa | gac | gtt | gaa | 1123 | |
| Asp | Glu | Thr | Ile | Ile | Val | Asp | Gly | Ala | Gly | Ser | Ala | Glu | Asp | Val | Glu | | |

| 330 | 335 | 340 | |
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| gca cgt cgc ggc cag atc cgt cgc gaa atc gcc aac acc gat tcc acc | | | 1171 |
| Ala Arg Arg Gly Gln Ile Arg Arg Glu Ile Ala Asn Thr Asp Ser Thr | | | |
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| tgg gat cgc gaa aag gca gaa gag cgt ttg gct aag ctc tcc ggt ggt | | | 1219 |
| Trp Asp Arg Glu Lys Ala Glu Glu Arg Leu Ala Lys Leu Ser Gly Gly | | | |
| 360 | 365 | 370 | |
| att gct gtc atc cgc gtt ggt gca gca act gaa acc gaa gtc aac gac | | | 1267 |
| Ile Ala Val Ile Arg Val Gly Ala Ala Thr Glu Thr Glu Val Asn Asp | | | |
| 375 | 380 | 385 | |
| cgc aag ctg cgt gtc gaa gat gcc atc aac gct gct cgc gca gca gca | | | 1315 |
| Arg Lys Leu Arg Val Glu Asp Ala Ile Asn Ala Ala Arg Ala Ala Ala | | | |
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| 1 | | | | 5 | | | | 10 | | | | | | 15 | |
| Arg | Gly | Val | Asp | Ala | Leu | Ala | Asn | Ala | Val | Lys | Val | Thr | Leu | Gly | Pro |
| | | | 20 | | | | | 25 | | | | | | 30 | |
| Arg | Gly | Arg | Asn | Val | Val | Leu | Asp | Lys | Ala | Phe | Gly | Gly | Pro | Leu | Val |
| | | | 35 | | | | 40 | | | | | 45 | | | |
| Thr | Asn | Asp | Gly | Val | Thr | Ile | Ala | Arg | Asp | Ile | Asp | Leu | Glu | Asp | Pro |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Phe | Glu | Asn | Leu | Gly | Ala | Gln | Leu | Val | Lys | Ser | Val | Ala | Val | Lys | Thr |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |
| Asn | Asp | Ile | Ala | Gly | Asp | Gly | Thr | Thr | Thr | Ala | Thr | Leu | Leu | Ala | Gln |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Ala | Leu | Ile | Ala | Glu | Gly | Leu | Arg | Asn | Val | Ala | Ala | Gly | Ala | Asn | Pro |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Met | Glu | Leu | Asn | Lys | Gly | Ile | Ser | Ala | Ala | Ala | Glu | Lys | Thr | Leu | Glu |
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| Glu | Leu | Lys | Ala | Arg | Ala | Thr | Glu | Val | Ser | Asp | Thr | Lys | Glu | Ile | Ala |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Asn | Val | Ala | Thr | Val | Ser | Ser | Arg | Asp | Glu | Val | Val | Gly | Glu | Ile | Val |

| | | | | | | |
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| 145 | | 150 | | 155 | | 160 |
| Ala Ala Ala Met | Glu Lys Val Gly Lys Asp Gly Val Val Thr Val Glu | | | | | |
| | 165 | | | 170 | | 175 |
| Glu Ser Gln Ser | Ile Glu Thr Ala Leu Glu Val Thr Glu Gly Ile Ser | | | | | |
| | 180 | | 185 | | | 190 |
| Phe Asp Lys Gly Tyr Leu Ser Pro Tyr Phe Ile Asn Asp Asn Asp Thr | | | | | | |
| | 195 | | 200 | | 205 | |
| Gln Gln Ala Val Leu Asp Asn Pro Ala Val Leu Leu Val Arg Asn Lys | | | | | | |
| | 210 | | 215 | | 220 | |
| Ile Ser Ser Leu Pro Asp Phe Leu Pro Leu Leu Glu Lys Val Val Glu | | | | | | |
| | 225 | | 230 | | 235 | 240 |
| Ser Asn Arg Pro Leu Leu Ile Ile Ala Glu Asp Val Glu Gly Glu Pro | | | | | | |
| | 245 | | 250 | | | 255 |
| Leu Gln Thr Leu Val Val Asn Ser Ile Arg Lys Thr Ile Lys Val Val | | | | | | |
| | 260 | | 265 | | | 270 |
| Ala Val Lys Ser Pro Tyr Phe Gly Asp Arg Arg Lys Ala Phe Met Asp | | | | | | |
| | 275 | | 280 | | 285 | |
| Asp Leu Ala Ile Val Thr Lys Ala Thr Val Val Asp Pro Glu Val Gly | | | | | | |
| | 290 | | 295 | | 300 | |
| Ile Asn Leu Asn Glu Ala Gly Glu Glu Val Phe Gly Thr Ala Arg Arg | | | | | | |
| | 305 | | 310 | | 315 | 320 |
| Ile Thr Val Ser Lys Asp Glu Thr Ile Ile Val Asp Gly Ala Gly Ser | | | | | | |
| | 325 | | 330 | | | 335 |
| Ala Glu Asp Val Glu Ala Arg Arg Gly Gln Ile Arg Arg Glu Ile Ala | | | | | | |
| | 340 | | 345 | | | 350 |
| Asn Thr Asp Ser Thr Trp Asp Arg Glu Lys Ala Glu Glu Arg Leu Ala | | | | | | |
| | 355 | | 360 | | 365 | |
| Lys Leu Ser Gly Gly Ile Ala Val Ile Arg Val Gly Ala Ala Thr Glu | | | | | | |
| | 370 | | 375 | | 380 | |
| Thr Glu Val Asn Asp Arg Lys Leu Arg Val Glu Asp Ala Ile Asn Ala | | | | | | |
| | 385 | | 390 | | 395 | 400 |
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 Met Ala Lys Tyr Gln
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acc att gag gct gct gtc cgc tct gag ttc ggc aag ggc tct gca cgt 163
 Thr Ile Glu Ala Ala Val Arg Ser Glu Phe Gly Lys Gly Ser Ala Arg
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cgt gca cgc gtt gct ggc cag atc cct gct gtt gtt tac ggc gca gat 211
 Arg Ala Arg Val Ala Gly Gln Ile Pro Ala Val Val Tyr Gly Ala Asp
 25 30 35

gtt gag tcc aac ctg cac gtc acc atc gac cac cgc acc ttc gct gcg 259
 Val Glu Ser Asn Leu His Val Thr Ile Asp His Arg Thr Phe Ala Ala
 40 45 50

ctg gtt cgc cag gaa ggc gta aac gct gtt ctt gag ctc gac atc gag 307
 Leu Val Arg Gln Glu Gly Val Asn Ala Val Leu Glu Leu Asp Ile Glu
 55 60 65

ggc cag aag cag ctc acc atg atc aag cac atc gac cag aac gtg ctg 355
 Gly Gln Lys Gln Leu Thr Met Ile Lys His Ile Asp Gln Asn Val Leu
 70 75 80 85

acc ttc cac atc gac cac ttg gac ctg ctt gcc att aag cgc ggc gaa 403
 Thr Phe His Ile Asp His Leu Asp Leu Leu Ala Ile Lys Arg Gly Glu
 90 95 100

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 Lys Val Glu Val Asp Val Pro Val Ile Val Glu Gly Glu Pro Ala Pro
 105 110 115

ggc acc atg tgg gtt cag gat gct gac acc atc aag gtt gag gct gac 499
 Gly Thr Met Trp Val Gln Asp Ala Asp Thr Ile Lys Val Glu Ala Asp
 120 125 130

gtt ctg tcc atc cct gaa gag ttc acc gtt tcc atc gaa ggc ctt gag 547
 Val Leu Ser Ile Pro Glu Glu Phe Thr Val Ser Ile Glu Gly Leu Glu
 135 140 145

ctc ggc gca cag atc acc gca gct gac atc aag ctc gag ggc gac acc 595
 Leu Gly Ala Gln Ile Thr Ala Ala Asp Ile Lys Leu Glu Gly Asp Thr
 150 155 160 165

acc ctg gtt gag gat cct gag acc ctc atc gtc aac atc gtt ctc cca 643
 Thr Leu Val Glu Asp Pro Glu Thr Leu Ile Val Asn Ile Val Leu Pro
 170 175 180

gct gtc gag gaa gaa gac acc gaa gag gac gaa gca gct gaa gaa gca 691
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185

190

195

gct act gag taagcttttt tagatagctt tat
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723

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 35 40 45
 Arg Thr Phe Ala Ala Leu Val Arg Gln Glu Gly Val Asn Ala Val Leu
 50 55 60
 Glu Leu Asp Ile Glu Gly Gln Lys Gln Leu Thr Met Ile Lys His Ile
 65 70 75 80
 Asp Gln Asn Val Leu Thr Phe His Ile Asp His Leu Asp Leu Leu Ala
 85 90 95
 Ile Lys Arg Gly Glu Lys Val Glu Val Asp Val Pro Val Ile Val Glu
 100 105 110
 Gly Glu Pro Ala Pro Gly Thr Met Trp Val Gln Asp Ala Asp Thr Ile
 115 120 125
 Lys Val Glu Ala Asp Val Leu Ser Ile Pro Glu Glu Phe Thr Val Ser
 130 135 140
 Ile Glu Gly Leu Glu Leu Gly Ala Gln Ile Thr Ala Ala Asp Ile Lys
 145 150 155 160
 Leu Glu Gly Asp Thr Thr Leu Val Glu Asp Pro Glu Thr Leu Ile Val
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Asp Gln Ile Val Asp Arg Gly Met Arg Pro Lys Leu Ser Gly Asn Thr
      10                      15                      20

acc cgc cac aac gga gca cca gtt cca tct gag aac atc tcc gca acc      149
Thr Arg His Asn Gly Ala Pro Val Pro Ser Glu Asn Ile Ser Ala Thr
      25                      30                      35

gca ggc cca cag ggt cca aac gtt ctc aat gac att cac ctc att gaa      197
Ala Gly Pro Gln Gly Pro Asn Val Leu Asn Asp Ile His Leu Ile Glu
      40                      45                      50                      55

aag ctc gca cac ttt aac cgc gag aac gtt cca gag cgt atc cct cac      245
Lys Leu Ala His Phe Asn Arg Glu Asn Val Pro Glu Arg Ile Pro His
                      60                      65                      70

gca aag ggc cac ggc gct ttc ggt gag ctg cac atc acc gag gac gta      293
Ala Lys Gly His Gly Ala Phe Gly Glu Leu His Ile Thr Glu Asp Val
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tcc gaa tac acc aag gca gac ctg ttc cag cct ggt aag gtc acc ccg      341
Ser Glu Tyr Thr Lys Ala Asp Leu Phe Gln Pro Gly Lys Val Thr Pro
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ctg gct gtt cgc ttc tct act gtt gct ggt gag cag ggc tcc cca gat      389
Leu Ala Val Arg Phe Ser Thr Val Ala Gly Glu Gln Gly Ser Pro Asp
      105                      110                      115

acc tgg cgc gac gtc cac ggc ttc gct ctt cgc ttc tac acc gaa gag      437
Thr Trp Arg Asp Val His Gly Phe Ala Leu Arg Phe Tyr Thr Glu Glu
      120                      125                      130                      135

ggc aac tac gac atc gtg ggt aac aac acc cca acc ttc ttc ctt cgt      485
Gly Asn Tyr Asp Ile Val Gly Asn Asn Thr Pro Thr Phe Phe Leu Arg
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gac ggc atg aag ttc ccg gac ttc atc cac tca cag aag cgt ctc aac      533
Asp Gly Met Lys Phe Pro Asp Phe Ile His Ser Gln Lys Arg Leu Asn
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aag aac ggt ctg cgc gat gca gac atg cag tgg gat ttc tgg acc cgc      581
Lys Asn Gly Leu Arg Asp Ala Asp Met Gln Trp Asp Phe Trp Thr Arg
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gca cct gaa tct gca cac cag gtg acc tac ctg atg ggt gac cgc ggt      629
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| cag tgg atc aac gct gaa ggt aag cca gtt tgg gtt aag tac cac ttc Gln Trp Ile Asn Ala Glu Gly Lys Pro Val Trp Val Lys Tyr His Phe 220 225 230 | | | 725 |
| aag acc cgc cag ggc tgg gat tgc ttc acc gat gca gaa gca gca aag Lys Thr Arg Gln Gly Trp Asp Cys Phe Thr Asp Ala Glu Ala Ala Lys 235 240 245 | | | 773 |
| gtt gca ggc gag aac gct gac tac cag cgc gaa gac ctc tac aac gct Val Ala Gly Glu Asn Ala Asp Tyr Gln Arg Glu Asp Leu Tyr Asn Ala 250 255 260 | | | 821 |
| att gaa aac ggc gac ttc cca atc tgg gac gtc aag gtt cag atc atg Ile Glu Asn Gly Asp Phe Pro Ile Trp Asp Val Lys Val Gln Ile Met 265 270 275 | | | 869 |
| cct ttc gag gat gca gag aac tac cgc tgg aac cca ttc gac ctg acc Pro Phe Glu Asp Ala Glu Asn Tyr Arg Trp Asn Pro Phe Asp Leu Thr 280 285 290 295 | | | 917 |
| aag acc tgg tcc cag aag gat tac cca ctg atc cca gtc ggt tac ttc Lys Thr Trp Ser Gln Lys Asp Tyr Pro Leu Ile Pro Val Gly Tyr Phe 300 305 310 | | | 965 |
| atc ctg aac cgc aac cca cgc aac ttc ttc gct cag atc gag cag ctt Ile Leu Asn Arg Asn Pro Arg Asn Phe Phe Ala Gln Ile Glu Gln Leu 315 320 325 | | | 1013 |
| gca ctg gat cca ggc aac atc gtt cct ggc gtc ggc ctg tcc cca gac Ala Leu Asp Pro Gly Asn Ile Val Pro Gly Val Gly Leu Ser Pro Asp 330 335 340 | | | 1061 |
| cgc atg ctc cag gca cgt atc ttc gca tac gct gac cag cag cgt tac Arg Met Leu Gln Ala Arg Ile Phe Ala Tyr Ala Asp Gln Gln Arg Tyr 345 350 355 | | | 1109 |
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| gag gtc aac acc tac agc cgc gaa ggt tcc atg cag tac atc ttc gac Glu Val Asn Thr Tyr Ser Arg Glu Gly Ser Met Gln Tyr Ile Phe Asp 380 385 390 | | | 1205 |
| gct gag ggc gag cct tcc tac agc cct aac cgc tac gac aag ggc gca Ala Glu Gly Glu Pro Ser Tyr Ser Pro Asn Arg Tyr Asp Lys Gly Ala 395 400 405 | | | 1253 |
| ggc tac ctg gat aac ggt acg gat tcc tcc tcc aac cac acc tcc tac Gly Tyr Leu Asp Asn Gly Thr Asp Ser Ser Ser Asn His Thr Ser Tyr 410 415 420 | | | 1301 |

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 Gly Gln Ala Asp Asp Ile Tyr Val Asn Pro Asp Pro His Gly Thr Asp
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 ctg gtt cgt gct gct tac gtc aag cac cag gat gat gac gac ttc atc 1397
 Leu Val Arg Ala Ala Tyr Val Lys His Gln Asp Asp Asp Asp Phe Ile
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 Gln Pro Gly Ile Leu Tyr Arg Glu Val Leu Asp Glu Gly Glu Lys Glu
 460 465 470

 cga ttg gca gac aac atc tcc aac gca atg cag ggc atc tct gag gca 1493
 Arg Leu Ala Asp Asn Ile Ser Asn Ala Met Gln Gly Ile Ser Glu Ala
 475 480 485

 acc gag cca cgc gtc tac gac tac tgg aac aac gtt gat gag aac ctc 1541
 Thr Glu Pro Arg Val Tyr Asp Tyr Trp Asn Asn Val Asp Glu Asn Leu
 490 495 500

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 Asn Asp Ile His Leu Ile Glu Lys Leu Ala His Phe Asn Arg Glu Asn
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 Val Pro Glu Arg Ile Pro His Ala Lys Gly His Gly Ala Phe Gly Glu
 65 70 75 80

 Leu His Ile Thr Glu Asp Val Ser Glu Tyr Thr Lys Ala Asp Leu Phe
 85 90 95

 Gln Pro Gly Lys Val Thr Pro Leu Ala Val Arg Phe Ser Thr Val Ala
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 Gly Glu Gln Gly Ser Pro Asp Thr Trp Arg Asp Val His Gly Phe Ala
 115 120 125

Leu Arg Phe Tyr Thr Glu Glu Gly Asn Tyr Asp Ile Val Gly Asn Asn
 130 135 140
 Thr Pro Thr Phe Phe Leu Arg Asp Gly Met Lys Phe Pro Asp Phe Ile
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 His Ser Gln Lys Arg Leu Asn Lys Asn Gly Leu Arg Asp Ala Asp Met
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 Gln Trp Asp Phe Trp Thr Arg Ala Pro Glu Ser Ala His Gln Val Thr
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 Tyr Leu Met Gly Asp Arg Gly Thr Pro Lys Thr Ser Arg His Gln Asp
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 Gly Phe Gly Ser His Thr Phe Gln Trp Ile Asn Ala Glu Gly Lys Pro
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 Val Trp Val Lys Tyr His Phe Lys Thr Arg Gln Gly Trp Asp Cys Phe
 225 230 235 240
 Thr Asp Ala Glu Ala Ala Lys Val Ala Gly Glu Asn Ala Asp Tyr Gln
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 Arg Glu Asp Leu Tyr Asn Ala Ile Glu Asn Gly Asp Phe Pro Ile Trp
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 Asp Val Lys Val Gln Ile Met Pro Phe Glu Asp Ala Glu Asn Tyr Arg
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 Trp Asn Pro Phe Asp Leu Thr Lys Thr Trp Ser Gln Lys Asp Tyr Pro
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 Leu Ile Pro Val Gly Tyr Phe Ile Leu Asn Arg Asn Pro Arg Asn Phe
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 Phe Ala Gln Ile Glu Gln Leu Ala Leu Asp Pro Gly Asn Ile Val Pro
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 Gly Val Gly Leu Ser Pro Asp Arg Met Leu Gln Ala Arg Ile Phe Ala
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 Tyr Ala Asp Gln Gln Arg Tyr Arg Ile Gly Ala Asn Tyr Arg Asp Leu
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 Pro Val Asn Arg Pro Ile Asn Glu Val Asn Thr Tyr Ser Arg Glu Gly
 370 375 380
 Ser Met Gln Tyr Ile Phe Asp Ala Glu Gly Glu Pro Ser Tyr Ser Pro
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 Asn Arg Tyr Asp Lys Gly Ala Gly Tyr Leu Asp Asn Gly Thr Asp Ser
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 Ser Ser Asn His Thr Ser Tyr Gly Gln Ala Asp Asp Ile Tyr Val Asn
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Pro Asp Pro His Gly Thr Asp Leu Val Arg Ala Ala Tyr Val Lys His
435 440 445

Gln Asp Asp Asp Asp Phe Ile Gln Pro Gly Ile Leu Tyr Arg Glu Val
450 455 460

Leu Asp Glu Gly Glu Lys Glu Arg Leu Ala Asp Asn Ile Ser Asn Ala
465 470 475 480

Met Gln Gly Ile Ser Glu Ala Thr Glu Pro Arg Val Tyr Asp Tyr Trp
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Val Ala Leu Lys Arg
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ccc gaa gag aaa aca gta aag atc gtg acc ata aaa cag act gac aac 163
Pro Glu Glu Lys Thr Val Lys Ile Val Thr Ile Lys Gln Thr Asp Asn
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atc aat gac gat gat ttg gtg tac agc aac gct act gac ctt cca gta 211
Ile Asn Asp Asp Asp Leu Val Tyr Ser Asn Ala Thr Asp Leu Pro Val
25 30 35

ggc gtg aag aag tcc cct aaa atg tca ccg acc gcc cgc gtt ggt ctc 259
Gly Val Lys Lys Ser Pro Lys Met Ser Pro Thr Ala Arg Val Gly Leu
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ctt gtc ttt ggg gtt atc gcg gcg gtg ggt tgg gga gca atc gct ttc 307
Leu Val Phe Gly Val Ile Ala Ala Val Gly Trp Gly Ala Ile Ala Phe
55 60 65

tcc cgt ggc gaa aca atc aac tct gtg tgg ctg gtt ttg gcg gca gtt 355
Ser Arg Gly Glu Thr Ile Asn Ser Val Trp Leu Val Leu Ala Ala Val
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|---|------|
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| Gly Ser Tyr Ile Ile Ala Phe Ser Phe Tyr Ala Arg Leu Ile Glu Tyr | |
| 90 95 100 | |
| aaa gtt gtt aag ccg aaa gat cag cga gca acc ccg gcg gaa tac gtt | 451 |
| Lys Val Val Lys Pro Lys Asp Gln Arg Ala Thr Pro Ala Glu Tyr Val | |
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| aat gac ggc aag gac tat gtc cca acg gat cgt cgt gtg ctt ttt ggc | 499 |
| Asn Asp Gly Lys Asp Tyr Val Pro Thr Asp Arg Arg Val Leu Phe Gly | |
| 120 125 130 | |
| cac cac ttt gca gct att gca ggt gcc ggt cca ttg gtt gga cct gtc | 547 |
| His His Phe Ala Ala Ile Ala Gly Ala Gly Pro Leu Val Gly Pro Val | |
| 135 140 145 | |
| atg gcc gcg cag atg ggc tac ctg cca ggc acc ttg tgg att atc ctc | 595 |
| Met Ala Ala Gln Met Gly Tyr Leu Pro Gly Thr Leu Trp Ile Ile Leu | |
| 150 155 160 165 | |
| ggt gtg att ttc gcc ggt gca gtg cag gac tac cta gtg ctg tgg gtg | 643 |
| Gly Val Ile Phe Ala Gly Ala Val Gln Asp Tyr Leu Val Leu Trp Val | |
| 170 175 180 | |
| tct act cgt agg cgt gga cgc tca ctt ggc cag atg gtt cgt gat gaa | 691 |
| Ser Thr Arg Arg Arg Gly Arg Ser Leu Gly Gln Met Val Arg Asp Glu | |
| 185 190 195 | |
| atg ggc acg gtc ggt gga gct gcc ggt atc ttg gcg acc atc tcc atc | 739 |
| Met Gly Thr Val Gly Gly Ala Ala Gly Ile Leu Ala Thr Ile Ser Ile | |
| 200 205 210 | |
| atg atc atc att atc gcg gtg ctc gca ttg atc gtg gtt aat gca ctg | 787 |
| Met Ile Ile Ile Ile Ala Val Leu Ala Leu Ile Val Val Asn Ala Leu | |
| 215 220 225 | |
| gct gat tca cca tgg ggc gtt ttc tcc atc acc atg acc atc cca att | 835 |
| Ala Asp Ser Pro Trp Gly Val Phe Ser Ile Thr Met Thr Ile Pro Ile | |
| 230 235 240 245 | |
| gca ctg ttc atg ggt gtg tac ttg cgt tac ctg cgc cca ggt cgt gtt | 883 |
| Ala Leu Phe Met Gly Val Tyr Leu Arg Tyr Leu Arg Pro Gly Arg Val | |
| 250 255 260 | |
| act gaa gtg tcc atc atc ggt gtg gca ctg ctc ctg ctg gct atc gtt | 931 |
| Thr Glu Val Ser Ile Ile Gly Val Ala Leu Leu Leu Leu Ala Ile Val | |
| 265 270 275 | |
| gct ggt ggt tgg gtt gca gac acc tca tgg ggc gtg gaa tgg ttc acc | 979 |
| Ala Gly Gly Trp Val Ala Asp Thr Ser Trp Gly Val Glu Trp Phe Thr | |
| 280 285 290 | |
| tgg tct aag acc act ttg gcg ttg gcc ttg atc ggt tac gga atc atg | 1027 |
| Trp Ser Lys Thr Thr Leu Ala Leu Ala Leu Ile Gly Tyr Gly Ile Met | |
| 295 300 305 | |
| gct gcg att ttg ccg gtg tgg ctg ctg ctt gca ccg cgc gat tac ctg | 1075 |

| | |
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| Ala Ala Ile Leu Pro Val Trp Leu Leu Leu Ala Pro Arg Asp Tyr Leu 310 315 320 325 | |
| tct acc ttt atg aag atc ggc gtc atc ggt ctg ttg gca gtg ggt att Ser Thr Phe Met Lys Ile Gly Val Ile Gly Leu Leu Ala Val Gly Ile 330 335 340 | 1123 |
| ttg ttc gca cgt cct gag gtg cag atg cct tcc gtg acc tcc ttc gca Leu Phe Ala Arg Pro Glu Val Gln Met Pro Ser Val Thr Ser Phe Ala 345 350 355 | 1171 |
| ctt gag ggc aac ggt ccg gtg ttc tct gga agt ctg ttc cca ttc ctg Leu Glu Gly Asn Gly Pro Val Phe Ser Gly Ser Leu Phe Pro Phe Leu 360 365 370 | 1219 |
| ttc atc acg att gcc tgt ggt gca ctg tct ggt ttc cac gca ctg att Phe Ile Thr Ile Ala Cys Gly Ala Leu Ser Gly Phe His Ala Leu Ile 375 380 385 | 1267 |
| tct tca gga acc aca cca aag ctt gtg gag aag gaa tcc cag atg cgc Ser Ser Gly Thr Thr Pro Lys Leu Val Glu Lys Glu Ser Gln Met Arg 390 395 400 405 | 1315 |
| atg ctc ggc tac ggc ggc atg ttg atg gaa tct ttc gtg gcg atg atg Met Leu Gly Tyr Gly Gly Met Leu Met Glu Ser Phe Val Ala Met Met 410 415 420 | 1363 |
| gca ctg atc acc gct gtt att ctg gat cgt cac ctg tac ttc tcc atg Ala Leu Ile Thr Ala Val Ile Leu Asp Arg His Leu Tyr Phe Ser Met 425 430 435 | 1411 |
| aac gct ccg ctg gca ctg act ggt gga gat cca gca acc gca gct gag Asn Ala Pro Leu Ala Leu Thr Gly Gly Asp Pro Ala Thr Ala Ala Glu 440 445 450 | 1459 |
| tgg gtt aac tcc att ggg ctg aca ggt gcg gat atc acc ccg gaa cag Trp Val Asn Ser Ile Gly Leu Thr Gly Ala Asp Ile Thr Pro Glu Gln 455 460 465 | 1507 |
| ctg tcg gaa gct gct gaa agt gtc gga gaa tcc act gtt att tcc cgt Leu Ser Glu Ala Ala Glu Ser Val Gly Glu Ser Thr Val Ile Ser Arg 470 475 480 485 | 1555 |
| acc ggt ggc gca cca acc ttg gcg ttc ggt atg tct gaa atc ctc tcc Thr Gly Gly Ala Pro Thr Leu Ala Phe Gly Met Ser Glu Ile Leu Ser 490 495 500 | 1603 |
| gga ttc atc ggc ggc gct gga atg aag gcg ttc tgg tac cac ttc gcc Gly Phe Ile Gly Gly Ala Gly Met Lys Ala Phe Trp Tyr His Phe Ala 505 510 515 | 1651 |
| atc atg ttt gag gct ctg ttc atc ctc act act gtg gat gca ggt act Ile Met Phe Glu Ala Leu Phe Ile Leu Thr Thr Val Asp Ala Gly Thr 520 525 530 | 1699 |
| cgt gtg gct cgc ttt atg atg acc gat acc ttg ggc aat gtt cca ggt Arg Val Ala Arg Phe Met Met Thr Asp Thr Leu Gly Asn Val Pro Gly 540 545 550 | 1747 |

| 535 | 540 | 545 | |
|---|-----|-----|------|
| ctg cgc cgt ttc aag gat cct tca tgg act gtc ggt aac tgg att tct | | | 1795 |
| Leu Arg Arg Phe Lys Asp Pro Ser Trp Thr Val Gly Asn Trp Ile Ser | | | |
| 550 | 555 | 560 | 565 |
| acc gtg ttt gtg tgt gct cta tgg ggt gct att ttg ctc atg ggt gtt | | | 1843 |
| Thr Val Phe Val Cys Ala Leu Trp Gly Ala Ile Leu Leu Met Gly Val | | | |
| | 570 | 575 | 580 |
| acc gat cca ctg ggc ggc atc aac gtg ctt ttc cca cta ttc ggt atc | | | 1891 |
| Thr Asp Pro Leu Gly Gly Ile Asn Val Leu Phe Pro Leu Phe Gly Ile | | | |
| | 585 | 590 | 595 |
| gct aac cag ctg ctc gcc gct att gca ctt gct ctc gtg ctg gtt gtt | | | 1939 |
| Ala Asn Gln Leu Leu Ala Ala Ile Ala Leu Ala Leu Val Leu Val Val | | | |
| | 600 | 605 | 610 |
| gtg gtg aag aag ggc ctg tac aag tgg gcg tgg att cca gct gtt cct | | | 1987 |
| Val Val Lys Lys Gly Leu Tyr Lys Trp Ala Trp Ile Pro Ala Val Pro | | | |
| | 615 | 620 | 625 |
| ttg gca tgg gat ctc att gtc acg atg act gcg tca tgg cag aag att | | | 2035 |
| Leu Ala Trp Asp Leu Ile Val Thr Met Thr Ala Ser Trp Gln Lys Ile | | | |
| | 630 | 635 | 640 |
| ttc cac tct gat ccg gct att ggc tac tgg gct cag aac gcg aac ttc | | | 2083 |
| Phe His Ser Asp Pro Ala Ile Gly Tyr Trp Ala Gln Asn Ala Asn Phe | | | |
| | 650 | 655 | 660 |
| cgc gat gca aag tct caa ggc ctt acc gaa ttt ggt gcc gct aaa tct | | | 2131 |
| Arg Asp Ala Lys Ser Gln Gly Leu Thr Glu Phe Gly Ala Ala Lys Ser | | | |
| | 665 | 670 | 675 |
| cct gag gca atc gat gcg gtt atc cga aac acc atg att cag ggc atc | | | 2179 |
| Pro Glu Ala Ile Asp Ala Val Ile Arg Asn Thr Met Ile Gln Gly Ile | | | |
| | 680 | 685 | 690 |
| ttg tcc atc ctg ttc gcg gtg ctc gtc ctc gtt gtt gtc ggc gca gcc | | | 2227 |
| Leu Ser Ile Leu Phe Ala Val Leu Val Leu Val Val Val Gly Ala Ala | | | |
| | 695 | 700 | 705 |
| att gcg gtg tgc atc aag tcc atc agg gct cgt gca gcc gga aca cct | | | 2275 |
| Ile Ala Val Cys Ile Lys Ser Ile Arg Ala Arg Ala Ala Gly Thr Pro | | | |
| | 710 | 715 | 720 |
| ttg gag acc act gaa gag cct gat act gaa tct gag ttc ttc gcc cca | | | 2323 |
| Leu Glu Thr Thr Glu Glu Pro Asp Thr Glu Ser Glu Phe Phe Ala Pro | | | |
| | 730 | 735 | 740 |
| act gga ttc ctt gca tct tcc agg gat aag gaa gtc cag gcc atg tgg | | | 2371 |
| Thr Gly Phe Leu Ala Ser Ser Arg Asp Lys Glu Val Gln Ala Met Trp | | | |
| | 745 | 750 | 755 |
| gac gag cgc tac cca ggc ggt gcg ccc gtg tct tct gga ggg cac | | | 2416 |
| Asp Glu Arg Tyr Pro Gly Gly Ala Pro Val Ser Ser Gly Gly His | | | |
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2439

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| Val | Ala | Leu | Lys | Arg | Pro | Glu | Glu | Lys | Thr | Val | Lys | Ile | Val | Thr | Ile |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Lys | Gln | Thr | Asp | Asn | Ile | Asn | Asp | Asp | Asp | Leu | Val | Tyr | Ser | Asn | Ala |
| | | | 20 | | | | | 25 | | | | | 30 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Thr | Asp | Leu | Pro | Val | Gly | Val | Lys | Lys | Ser | Pro | Lys | Met | Ser | Pro | Thr |
| | | 35 | | | | | 40 | | | | | 45 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Arg | Val | Gly | Leu | Leu | Val | Phe | Gly | Val | Ile | Ala | Ala | Val | Gly | Trp |
| | 50 | | | | | 55 | | | | | 60 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Gly | Ala | Ile | Ala | Phe | Ser | Arg | Gly | Glu | Thr | Ile | Asn | Ser | Val | Trp | Leu |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Leu | Ala | Ala | Val | Gly | Ser | Tyr | Ile | Ile | Ala | Phe | Ser | Phe | Tyr | Ala |
| | | | | 85 | | | | | 90 | | | | | 95 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Arg | Leu | Ile | Glu | Tyr | Lys | Val | Val | Lys | Pro | Lys | Asp | Gln | Arg | Ala | Thr |
| | | | 100 | | | | | 105 | | | | | 110 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Pro | Ala | Glu | Tyr | Val | Asn | Asp | Gly | Lys | Asp | Tyr | Val | Pro | Thr | Asp | Arg |
| | | 115 | | | | | 120 | | | | | 125 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Arg | Val | Leu | Phe | Gly | His | His | Phe | Ala | Ala | Ile | Ala | Gly | Ala | Gly | Pro |
| | 130 | | | | | 135 | | | | | 140 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Val | Gly | Pro | Val | Met | Ala | Ala | Gln | Met | Gly | Tyr | Leu | Pro | Gly | Thr |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Trp | Ile | Ile | Leu | Gly | Val | Ile | Phe | Ala | Gly | Ala | Val | Gln | Asp | Tyr |
| | | | | 165 | | | | | 170 | | | | | 175 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Val | Leu | Trp | Val | Ser | Thr | Arg | Arg | Arg | Gly | Arg | Ser | Leu | Gly | Gln |
| | | | 180 | | | | | 185 | | | | | 190 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Val | Arg | Asp | Glu | Met | Gly | Thr | Val | Gly | Gly | Ala | Ala | Gly | Ile | Leu |
| | | 195 | | | | | 200 | | | | | 205 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Thr | Ile | Ser | Ile | Met | Ile | Ile | Ile | Ile | Ala | Val | Leu | Ala | Leu | Ile |
| | 210 | | | | | 215 | | | | | | 220 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Val | Asn | Ala | Leu | Ala | Asp | Ser | Pro | Trp | Gly | Val | Phe | Ser | Ile | Thr |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Thr | Ile | Pro | Ile | Ala | Leu | Phe | Met | Gly | Val | Tyr | Leu | Arg | Tyr | Leu |
| | | | | 245 | | | | | 250 | | | | | 255 | |

Arg Pro Gly Arg Val Thr Glu Val Ser Ile Ile Gly Val Ala Leu Leu
 260 265 270
 Leu Leu Ala Ile Val Ala Gly Gly Trp Val Ala Asp Thr Ser Trp Gly
 275 280 285
 Val Glu Trp Phe Thr Trp Ser Lys Thr Thr Leu Ala Leu Ala Leu Ile
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 Gly Tyr Gly Ile Met Ala Ala Ile Leu Pro Val Trp Leu Leu Leu Ala
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 Pro Arg Asp Tyr Leu Ser Thr Phe Met Lys Ile Gly Val Ile Gly Leu
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 Leu Ala Val Gly Ile Leu Phe Ala Arg Pro Glu Val Gln Met Pro Ser
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 Val Thr Ser Phe Ala Leu Glu Gly Asn Gly Pro Val Phe Ser Gly Ser
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 Leu Phe Pro Phe Leu Phe Ile Thr Ile Ala Cys Gly Ala Leu Ser Gly
 370 375 380
 Phe His Ala Leu Ile Ser Ser Gly Thr Thr Pro Lys Leu Val Glu Lys
 385 390 395 400
 Glu Ser Gln Met Arg Met Leu Gly Tyr Gly Gly Met Leu Met Glu Ser
 405 410 415
 Phe Val Ala Met Met Ala Leu Ile Thr Ala Val Ile Leu Asp Arg His
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 Leu Tyr Phe Ser Met Asn Ala Pro Leu Ala Leu Thr Gly Gly Asp Pro
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 485 490 495
 Ser Glu Ile Leu Ser Gly Phe Ile Gly Gly Ala Gly Met Lys Ala Phe
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 Trp Tyr His Phe Ala Ile Met Phe Glu Ala Leu Phe Ile Leu Thr Thr
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 Val Asp Ala Gly Thr Arg Val Ala Arg Phe Met Met Thr Asp Thr Leu
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 Gly Asn Val Pro Gly Leu Arg Arg Phe Lys Asp Pro Ser Trp Thr Val
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Gly Asn Trp Ile Ser Thr Val Phe Val Cys Ala Leu Trp Gly Ala Ile
 565 570 575
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 Pro Leu Phe Gly Ile Ala Asn Gln Leu Leu Ala Ala Ile Ala Leu Ala
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 Leu Val Leu Val Val Val Val Lys Lys Gly Leu Tyr Lys Trp Ala Trp
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 Ile Pro Ala Val Pro Leu Ala Trp Asp Leu Ile Val Thr Met Thr Ala
 625 630 635 640
 Ser Trp Gln Lys Ile Phe His Ser Asp Pro Ala Ile Gly Tyr Trp Ala
 645 650 655
 Gln Asn Ala Asn Phe Arg Asp Ala Lys Ser Gln Gly Leu Thr Glu Phe
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 Gly Ala Ala Lys Ser Pro Glu Ala Ile Asp Ala Val Ile Arg Asn Thr
 675 680 685
 Met Ile Gln Gly Ile Leu Ser Ile Leu Phe Ala Val Leu Val Leu Val
 690 695 700
 Val Val Gly Ala Ala Ile Ala Val Cys Ile Lys Ser Ile Arg Ala Arg
 705 710 715 720
 Ala Ala Gly Thr Pro Leu Glu Thr Thr Glu Glu Pro Asp Thr Glu Ser
 725 730 735
 Glu Phe Phe Ala Pro Thr Gly Phe Leu Ala Ser Ser Arg Asp Lys Glu
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 Met Ala Val Tyr Glu
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ctc cca gaa ctc gac tac gca tac gac gct ctc gag cca cac atc gtc 163
 Leu Pro Glu Leu Asp Tyr Ala Tyr Asp Ala Leu Glu Pro His Ile Val
 10 15 20

gct gaa atc atg gag ctt gac cag tcc aag gac cac gca acc tac gtt 211
 Ala Glu Ile Met Glu Leu Asp Gln Ser Lys Asp His Ala Thr Tyr Val
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<211> 44

<212> PRT

<213> Corynebacterium glutamicum

<400> 16

Met Ala Val Tyr Glu Leu Pro Glu Leu Asp Tyr Ala Tyr Asp Ala Leu
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 20 25 30

His Ala Thr Tyr Val Ala Gly Ala Asn Ala Ala Leu
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<211> 249

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(226)

<223> RXN03120

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 Met Leu Asp Met Trp
 1 5

gag cac gct ttc tac ctg cag tac atg aac gtt aag gca gat tac gtc 163
 Glu His Ala Phe Tyr Leu Gln Tyr Met Asn Val Lys Ala Asp Tyr Val
 10 15 20

aag gct gtt tgg aac gtc ttc aac tgg gac gac gca aga gca cgc ttc 211
 Lys Ala Val Trp Asn Val Phe Asn Trp Asp Asp Ala Arg Ala Arg Phe
 25 30 35

gca gca gct tcc aag taagcatttt tagtccgtgc aat
 Ala Ala Ala Ser Lys
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249

<210> 18
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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 18
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 Lys Ala Asp Tyr Val Lys Ala Val Trp Asn Val Phe Asn Trp Asp Asp
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 Ala Arg Ala Arg Phe Ala Ala Ala Ser Lys
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 Met Val Glu Arg Asp
 1 5
 ttc act atc cga cca atc cgc gag ggt gat ttc cct cag gtg agg gac 163
 Phe Thr Ile Arg Pro Ile Arg Glu Gly Asp Phe Pro Gln Val Arg Asp
 10 15 20
 atc tac gaa ttg ggc ctg gag acg gga cat gcg act tat gag act tct 211
 Ile Tyr Glu Leu Gly Leu Glu Thr Gly His Ala Thr Tyr Glu Thr Ser
 25 30 35
 ggt ccc acg tgg gac cag ttc tcc caa tct aaa atc atg gat acc gtc 259
 Gly Pro Thr Trp Asp Gln Phe Ser Gln Ser Lys Ile Met Asp Thr Val
 40 45 50
 atg gtg gcg gta gaa aac aac gac ccg gac ttc atc ctc gga tgg gtg 307
 Met Val Ala Val Glu Asn Asn Asp Pro Asp Phe Ile Leu Gly Trp Val
 55 60 65
 tct gct gct cca att tca agc cga cag gtt ttc cat gga gtg gtg gaa 355
 Ser Ala Ala Pro Ile Ser Ser Arg Gln Val Phe His Gly Val Val Glu

| 70 | 75 | 80 | 85 | |
|---|-----|-----|-----|-----|
| gat tcc atc tat atc cac ccc cag ggc caa ggc cga gga atc ggc ggc | | | | 403 |
| Asp Ser Ile Tyr Ile His Pro Gln Gly Gln Gly Arg Gly Ile Gly Gly | 90 | 95 | 100 | |
| gct ttg ctc gac gcc ctt atc acc tac tgc gaa agc aac ggc atc tgg | | | | 451 |
| Ala Leu Leu Asp Ala Leu Ile Thr Tyr Cys Glu Ser Asn Gly Ile Trp | 105 | 110 | 115 | |
| tcg atc cac tcc tgg atc ttc ccg gaa aac ctc ggt tct gcg aaa ctg | | | | 499 |
| Ser Ile His Ser Trp Ile Phe Pro Glu Asn Leu Gly Ser Ala Lys Leu | 120 | 125 | 130 | |
| cat gaa tcg aag ggc ttc gtg aag gtg ggc acc atg cac caa atg gca | | | | 547 |
| His Glu Ser Lys Gly Phe Val Lys Val Gly Thr Met His Gln Met Ala | 135 | 140 | 145 | |
| agg atg ccc tac ggc gag atg gaa gga caa tgg cgc gat tgt gat ctg | | | | 595 |
| Arg Met Pro Tyr Gly Glu Met Glu Gly Gln Trp Arg Asp Cys Asp Leu | 150 | 155 | 160 | 165 |
| tgg gag tgc ctc tta tcc gtt cca gag caa gct caa agt tcc | | | | 637 |
| Trp Glu Cys Leu Leu Ser Val Pro Glu Gln Ala Gln Ser Ser | 170 | 175 | | |
| taaagcaatt taaatctgac ttt | | | | 660 |

<210> 20

<211> 179

<212> PRT

<213> Corynebacterium glutamicum

<400> 20

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| Met Val Glu Arg Asp Phe Thr Ile Arg Pro Ile Arg Glu Gly Asp Phe | |
| 1 5 10 15 | |

| | |
|---|--|
| Pro Gln Val Arg Asp Ile Tyr Glu Leu Gly Leu Glu Thr Gly His Ala | |
| 20 25 30 | |

| | |
|---|--|
| Thr Tyr Glu Thr Ser Gly Pro Thr Trp Asp Gln Phe Ser Gln Ser Lys | |
| 35 40 45 | |

| | |
|---|--|
| Ile Met Asp Thr Val Met Val Ala Val Glu Asn Asn Asp Pro Asp Phe | |
| 50 55 60 | |

| | |
|---|--|
| Ile Leu Gly Trp Val Ser Ala Ala Pro Ile Ser Ser Arg Gln Val Phe | |
| 65 70 75 80 | |

| | |
|---|--|
| His Gly Val Val Glu Asp Ser Ile Tyr Ile His Pro Gln Gly Gln Gly | |
| 85 90 95 | |

| | |
|---|--|
| Arg Gly Ile Gly Gly Ala Leu Leu Asp Ala Leu Ile Thr Tyr Cys Glu | |
| 100 105 110 | |

| | |
|---|--|
| Ser Asn Gly Ile Trp Ser Ile His Ser Trp Ile Phe Pro Glu Asn Leu | |
|---|--|

| | | | | | | | | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-----|
| <400> 21 | | | | | | | | | | | | | | | | |
| gcatgtccgg ttgccgatct atttaaatac caggacaatt gcgtgcatgg ttgaaagaga | | | | | | | | | | | | | | | | 60 |
| cttcactatc cgaccaatcc gcgagggtga tttccctcag | | | | | | | | | | | | | | | | 115 |
| <div style="display: flex; justify-content: space-between;"> Val Arg Asp Ile Tyr 1 5 </div> | | | | | | | | | | | | | | | | |
| gaa ttg ggc ctg gag acg gga cat gcg act tat gag act tct ggt ccc | | | | | | | | | | | | | | | | 163 |
| <div style="display: flex; justify-content: space-between;"> Glu Leu Gly Leu Glu Thr Gly His Ala Thr Tyr Glu Thr Ser Gly Pro 10 15 20 </div> | | | | | | | | | | | | | | | | |
| acg tgg gac cag ttc tcc caa tct aaa atc atg gat acc gtc atg gtg | | | | | | | | | | | | | | | | 211 |
| <div style="display: flex; justify-content: space-between;"> Thr Trp Asp Gln Phe Ser Gln Ser Lys Ile Met Asp Thr Val Met Val 25 30 35 </div> | | | | | | | | | | | | | | | | |
| gcg gta gaa aac aac gac ccg gac ttc atc ctc gga tgg gtg tct gct | | | | | | | | | | | | | | | | 259 |
| <div style="display: flex; justify-content: space-between;"> Ala Val Glu Asn Asn Asp Pro Asp Phe Ile Leu Gly Trp Val Ser Ala 40 45 50 </div> | | | | | | | | | | | | | | | | |
| gct cca att tca agc cga cag gtt ttc cat gga gtg gtg gaa gat tcc | | | | | | | | | | | | | | | | 307 |
| <div style="display: flex; justify-content: space-between;"> Ala Pro Ile Ser Ser Arg Gln Val Phe His Gly Val Val Glu Asp Ser 55 60 65 </div> | | | | | | | | | | | | | | | | |
| atc tat atc cac ccc cag ggc caa ggc cga gga atc ggc ggc gct ttg | | | | | | | | | | | | | | | | 355 |
| <div style="display: flex; justify-content: space-between;"> Ile Tyr Ile His Pro Gln Gly Gln Gly Arg Gly Ile Gly Gly Ala Leu 70 75 80 85 </div> | | | | | | | | | | | | | | | | |
| ctc gac gcc ctt atc acc tac tgc gaa agc aac ggc atc tgg tcg atc | | | | | | | | | | | | | | | | 403 |
| <div style="display: flex; justify-content: space-between;"> Leu Asp Ala Leu Ile Thr Tyr Cys Glu Ser Asn Gly Ile Trp Ser Ile 90 95 100 </div> | | | | | | | | | | | | | | | | |
| cac tcc tgg atc ttc ccg gaa aac ctc qgt tct gcg aaa ctg cat gaa | | | | | | | | | | | | | | | | 451 |

His Ser Trp Ile Phe Pro Glu Asn Leu Gly Ser Ala Lys Leu His Glu
 105 110 115

tcg aag ggc ttc gtg aag gtg ggc acc atg cac caa atg gca agg atg 499
 Ser Lys Gly Phe Val Lys Val Gly Thr Met His Gln Met Ala Arg Met
 120 125 130

ccc tac ggc gag atg gaa gga caa tgg cgc gat tgt gat ctg tgg gag 547
 Pro Tyr Gly Glu Met Glu Gly Gln Trp Arg Asp Cys Asp Leu Trp Glu
 135 140 145

tgc ctc tta tcc gtt cca gag caa gct caa agt tcc taaagcaatt 593
 Cys Leu Leu Ser Val Pro Glu Gln Ala Gln Ser Ser
 150 155 160

taaatctgac ttt 606

<210> 22
 <211> 161
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 22
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Glu Thr Ser Gly Pro Thr Trp Asp Gln Phe Ser Gln Ser Lys Ile Met
 20 25 30

Asp Thr Val Met Val Ala Val Glu Asn Asn Asp Pro Asp Phe Ile Leu
 35 40 45

Gly Trp Val Ser Ala Ala Pro Ile Ser Ser Arg Gln Val Phe His Gly
 50 55 60

Val Val Glu Asp Ser Ile Tyr Ile His Pro Gln Gly Gln Gly Arg Gly
 65 70 75 80

Ile Gly Gly Ala Leu Leu Asp Ala Leu Ile Thr Tyr Cys Glu Ser Asn
 85 90 95

Gly Ile Trp Ser Ile His Ser Trp Ile Phe Pro Glu Asn Leu Gly Ser
 100 105 110

Ala Lys Leu His Glu Ser Lys Gly Phe Val Lys Val Gly Thr Met His
 115 120 125

Gln Met Ala Arg Met Pro Tyr Gly Glu Met Glu Gly Gln Trp Arg Asp
 130 135 140

Cys Asp Leu Trp Glu Cys Leu Leu Ser Val Pro Glu Gln Ala Gln Ser
 145 150 155 160

Ser

<210> 23
 <211> 1575
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1552)
 <223> RXN01345

<400> 23

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ttccactgca cagcccgaaa atgctgctag ggtcaagttc atg cgt ttt gga ctt 115
                               Met Arg Phe Gly Leu
                               1           5

gac ttg gga act acc cgc aca atc gcg gcc gcc gtg gac cgc gga aac 163
Asp Leu Gly Thr Thr Arg Thr Ile Ala Ala Ala Val Asp Arg Gly Asn
                        10           15           20

tat ccc atc gtc act gtg gaa gat tct tta ggc gac acc cac gat ttc 211
Tyr Pro Ile Val Thr Val Glu Asp Ser Leu Gly Asp Thr His Asp Phe
                        25           30           35

att cca tct gtg gtg gcc ctc aag gca gat agg att gtc gcg ggt tgg 259
Ile Pro Ser Val Val Ala Leu Lys Ala Asp Arg Ile Val Ala Gly Trp
                        40           45           50

gat gct att gag gtt ggg cag gac cac cct tcc ttc gta cgt tct ttc 307
Asp Ala Ile Glu Val Gly Gln Asp His Pro Ser Phe Val Arg Ser Phe
                        55           60           65

aaa cgc cta ctc tct gaa ccc aat gtc acg gaa gcc acc ccg gtc tac 355
Lys Arg Leu Leu Ser Glu Pro Asn Val Thr Glu Ala Thr Pro Val Tyr
                        70           75           80           85

ttg ggc gat cat gta cac cct ttg ggc gcc gtc ctg gag gct ttt gcg 403
Leu Gly Asp His Val His Pro Leu Gly Ala Val Leu Glu Ala Phe Ala
                        90           95           100

gaa aac gtg gtc act gcg ctg cgt gca ttt cag acg caa ttg gga gat 451
Glu Asn Val Val Thr Ala Leu Arg Ala Phe Gln Thr Gln Leu Gly Asp
                        105           110           115

acc tcc ccg atc gaa gta gtc att ggt gtg ccc gcc aac tcc cac agc 499
Thr Ser Pro Ile Glu Val Val Ile Gly Val Pro Ala Asn Ser His Ser
                        120           125           130

gcc cag cga ctg ctc acc atg tcc gcc ttc agc gcc aca ggc atc acc 547
Ala Gln Arg Leu Leu Thr Met Ser Ala Phe Ser Ala Thr Gly Ile Thr
                        135           140           145

gtt gtc ggt ttg gtc aat gag ccc agc gcc gca gct ttc gag tac acc 595
Val Val Gly Leu Val Asn Glu Pro Ser Ala Ala Ala Phe Glu Tyr Thr
150           155           160           165
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| | |
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| cac cgc cac gcc cgc acc tta aac tcc aag cgc caa gcc atc gtg gtt His Arg His Ala Arg Thr Leu Asn Ser Lys Arg Gln Ala Ile Val Val 170 175 180 | 643 |
| tat gat ttg gga ggc gga aca ttc gac tcc tcg ctc atc cgc atc gac Tyr Asp Leu Gly Gly Gly Thr Phe Asp Ser Ser Leu Ile Arg Ile Asp 185 190 195 | 691 |
| ggc acc cac cac gag gtt gtg tcc tcc att ggc att tca cgc ctt ggt Gly Thr His His Glu Val Val Ser Ser Ile Gly Ile Ser Arg Leu Gly 200 205 210 | 739 |
| ggc gat gat ttc gat gaa atc ctc ctc caa tgc gcg ctc aag gcc gca Gly Asp Asp Phe Asp Glu Ile Leu Leu Gln Cys Ala Leu Lys Ala Ala 215 220 225 | 787 |
| ggc aga cag cac gat gcg ttt ggc aag cgt gct aaa aac acg ctt ctc Gly Arg Gln His Asp Ala Phe Gly Lys Arg Ala Lys Asn Thr Leu Leu 230 235 240 245 | 835 |
| gac gaa tcc cgc aac gcg aag gaa gct ctt gtt ccg caa tcc cgt cgc Asp Glu Ser Arg Asn Ala Lys Glu Ala Leu Val Pro Gln Ser Arg Arg 250 255 260 | 883 |
| ttg gtt cta gaa att ggc gac gac gac atc acc gtt cca gtg aac aag Leu Val Leu Glu Ile Gly Asp Asp Asp Ile Thr Val Pro Val Asn Lys 265 270 275 | 931 |
| ttc tac gag gct gcc act ccc ctg gtg gaa aaa tcc ttg tcc atc atg Phe Tyr Glu Ala Ala Thr Pro Leu Val Glu Lys Ser Leu Ser Ile Met 280 285 290 | 979 |
| gaa ccc ctc atc ggc gtc gat gat ctt aaa gat tcc gac atc gca ggc Glu Pro Leu Ile Gly Val Asp Asp Leu Lys Asp Ser Asp Ile Ala Gly 295 300 305 | 1027 |
| atc tac ctt gtt ggt gga gga tcc tcg ctc cca ctc gtt tcc agg ttg Ile Tyr Leu Val Gly Gly Gly Ser Ser Leu Pro Leu Val Ser Arg Leu 310 315 320 325 | 1075 |
| ctc cgc gag cgt ttc ggc cgc cgt gtc cac cgc tcc cca ttc ccc tca Leu Arg Glu Arg Phe Gly Arg Arg Val His Arg Ser Pro Phe Pro Ser 330 335 340 | 1123 |
| ggt tcc act gcg gtg ggt ctg gcc atc gcg gct gac cct tcc tct ggt Gly Ser Thr Ala Val Gly Leu Ala Ile Ala Ala Asp Pro Ser Ser Gly 345 350 355 | 1171 |
| ttc cac cta agg gac cgc gtt gcg cga ggc atc ggt gtg ttc cgt gag Phe His Leu Arg Asp Arg Val Ala Arg Gly Ile Gly Val Phe Arg Glu 360 365 370 | 1219 |
| cac gat tct ggt cgt gcc gtg agc ttt gac ccg ctg atc gcc ccg gac His Asp Ser Gly Arg Ala Val Ser Phe Asp Pro Leu Ile Ala Pro Asp 375 380 385 | 1267 |

acc gat tct gcg acc gtg gcg aaa cga tgc tac aag gcg gtg cac aac 1315
 Thr Asp Ser Ala Thr Val Ala Lys Arg Cys Tyr Lys Ala Val His Asn
 390 395 400 405

att ggt tgg ttc agg ttc gtg gaa tac tcc acc gtg tcc gag gat ggc 1363
 Ile Gly Trp Phe Arg Phe Val Glu Tyr Ser Thr Val Ser Glu Asp Gly
 410 415 420

agc ccc gga gat att tcc ctg ctc agt gaa atc aag att cct ttt gat 1411
 Ser Pro Gly Asp Ile Ser Leu Leu Ser Glu Ile Lys Ile Pro Phe Asp
 425 430 435

agc tcc atc acc gat gtg gat gct acc gag att tca cgt ttc gat ggc 1459
 Ser Ser Ile Thr Asp Val Asp Ala Thr Glu Ile Ser Arg Phe Asp Gly
 440 445 450

cca gaa gta gaa gaa acc atc aca gtc aat gac aac ggc gtg gct tcc 1507
 Pro Glu Val Glu Glu Thr Ile Thr Val Asn Asp Asn Gly Val Ala Ser
 455 460 465

att tcc atc aag ata ctc ggc ggc gtt acc gtc gag cac aca att 1552
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<210> 24
 <211> 484
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 24
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 20 25 30

Asp Thr His Asp Phe Ile Pro Ser Val Val Ala Leu Lys Ala Asp Arg
 35 40 45

Ile Val Ala Gly Trp Asp Ala Ile Glu Val Gly Gln Asp His Pro Ser
 50 55 60

Phe Val Arg Ser Phe Lys Arg Leu Leu Ser Glu Pro Asn Val Thr Glu
 65 70 75 80

Ala Thr Pro Val Tyr Leu Gly Asp His Val His Pro Leu Gly Ala Val
 85 90 95

Leu Glu Ala Phe Ala Glu Asn Val Val Thr Ala Leu Arg Ala Phe Gln
 100 105 110

Thr Gln Leu Gly Asp Thr Ser Pro Ile Glu Val Val Ile Gly Val Pro
 115 120 125

Ala Asn Ser His Ser Ala Gln Arg Leu Leu Thr Met Ser Ala Phe Ser
 130 135 140
 Ala Thr Gly Ile Thr Val Val Gly Leu Val Asn Glu Pro Ser Ala Ala
 145 150 155 160
 Ala Phe Glu Tyr Thr His Arg His Ala Arg Thr Leu Asn Ser Lys Arg
 165 170 175
 Gln Ala Ile Val Val Tyr Asp Leu Gly Gly Gly Thr Phe Asp Ser Ser
 180 185 190
 Leu Ile Arg Ile Asp Gly Thr His His Glu Val Val Ser Ser Ile Gly
 195 200 205
 Ile Ser Arg Leu Gly Gly Asp Asp Phe Asp Glu Ile Leu Leu Gln Cys
 210 215 220
 Ala Leu Lys Ala Ala Gly Arg Gln His Asp Ala Phe Gly Lys Arg Ala
 225 230 235 240
 Lys Asn Thr Leu Leu Asp Glu Ser Arg Asn Ala Lys Glu Ala Leu Val
 245 250 255
 Pro Gln Ser Arg Arg Leu Val Leu Glu Ile Gly Asp Asp Asp Ile Thr
 260 265 270
 Val Pro Val Asn Lys Phe Tyr Glu Ala Ala Thr Pro Leu Val Glu Lys
 275 280 285
 Ser Leu Ser Ile Met Glu Pro Leu Ile Gly Val Asp Asp Leu Lys Asp
 290 295 300
 Ser Asp Ile Ala Gly Ile Tyr Leu Val Gly Gly Gly Ser Ser Leu Pro
 305 310 315 320
 Leu Val Ser Arg Leu Leu Arg Glu Arg Phe Gly Arg Arg Val His Arg
 325 330 335
 Ser Pro Phe Pro Ser Gly Ser Thr Ala Val Gly Leu Ala Ile Ala Ala
 340 345 350
 Asp Pro Ser Ser Gly Phe His Leu Arg Asp Arg Val Ala Arg Gly Ile
 355 360 365
 Gly Val Phe Arg Glu His Asp Ser Gly Arg Ala Val Ser Phe Asp Pro
 370 375 380
 Leu Ile Ala Pro Asp Thr Asp Ser Ala Thr Val Ala Lys Arg Cys Tyr
 385 390 395 400
 Lys Ala Val His Asn Ile Gly Trp Phe Arg Phe Val Glu Tyr Ser Thr
 405 410 415
 Val Ser Glu Asp Gly Ser Pro Gly Asp Ile Ser Leu Leu Ser Glu Ile
 420 425 430

Lys Ile Pro Phe Asp Ser Ser Ile Thr Asp Val Asp Ala Thr Glu Ile
 435 440 445

Ser Arg Phe Asp Gly Pro Glu Val Glu Glu Thr Ile Thr Val Asn Asp
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Asn Gly Val Ala Ser Ile Ser Ile Lys Ile Leu Gly Gly Val Thr Val
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Glu His Thr Ile

<210> 25

<211> 1267

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1267)

<223> FRXA01345

<400> 25

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 Met Arg Phe Gly Leu
 1 5

gac ttg gga act acc cgc aca atc gcg gcc gcc gtg gac cgc gga aac 163
 Asp Leu Gly Thr Thr Arg Thr Ile Ala Ala Ala Val Asp Arg Gly Asn
 10 15 20

tat ccc atc gtc act gtg gaa gat tct tta ggc gac acc cac gat ttc 211
 Tyr Pro Ile Val Thr Val Glu Asp Ser Leu Gly Asp Thr His Asp Phe
 25 30 35

att cca tct gtg gtg gcc ctc aag gca gat agg att gtc gcg ggt tgg 259
 Ile Pro Ser Val Val Ala Leu Lys Ala Asp Arg Ile Val Ala Gly Trp
 40 45 50

gat gct att gag gtt ggg cag gac cac cct tcc ttc gta cgt tct ttc 307
 Asp Ala Ile Glu Val Gly Gln Asp His Pro Ser Phe Val Arg Ser Phe
 55 60 65

aaa cgc cta ctc tct gaa ccc aat gtc acg gaa gcc acc ccg gtc tac 355
 Lys Arg Leu Leu Ser Glu Pro Asn Val Thr Glu Ala Thr Pro Val Tyr
 70 75 80 85

ttg ggc gat cat gta cac cct ttg ggc gcc gtc ctg gag gct ttt gcg 403
 Leu Gly Asp His Val His Pro Leu Gly Ala Val Leu Glu Ala Phe Ala
 90 95 100

gaa aac gtg gtc act gcg ctg cgt gca ttt cag acg caa ttg gga gat 451
 Glu Asn Val Val Thr Ala Leu Arg Ala Phe Gln Thr Gln Leu Gly Asp
 105 110 115

| | |
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| acc tcc ccg atc gaa gta gtc att ggt gtg ccc gcc aac tcc cac agc | 499 |
| Thr Ser Pro Ile Glu Val Val Ile Gly Val Pro Ala Asn Ser His Ser | |
| 120 125 130 | |
| gcc cag cga ctg ctc acc atg tcc gcc ttc agc gcc aca ggc atc acc | 547 |
| Ala Gln Arg Leu Leu Thr Met Ser Ala Phe Ser Ala Thr Gly Ile Thr | |
| 135 140 145 | |
| gtt gtc ggt ttg gtc aat gag ccc agc gcc gca gct ttc gag tac acc | 595 |
| Val Val Gly Leu Val Asn Glu Pro Ser Ala Ala Ala Phe Glu Tyr Thr | |
| 150 155 160 165 | |
| cac cgc cac gcc cgc acc tta aac tcc aag cgc caa gcc atc gtg gtt | 643 |
| His Arg His Ala Arg Thr Leu Asn Ser Lys Arg Gln Ala Ile Val Val | |
| 170 175 180 | |
| tat gat ttg gga ggc gga aca ttc gac tcc tcg ctc atc cgc atc gac | 691 |
| Tyr Asp Leu Gly Gly Gly Thr Phe Asp Ser Ser Leu Ile Arg Ile Asp | |
| 185 190 195 | |
| ggc acc cac cac gag gtt gtg tcc tcc att ggc att tca cgc ctt ggt | 739 |
| Gly Thr His His Glu Val Val Ser Ser Ile Gly Ile Ser Arg Leu Gly | |
| 200 205 210 | |
| ggc gat gat ttc gat gaa atc ctc ctc caa tgc gcg ctc aag gcc gca | 787 |
| Gly Asp Asp Phe Asp Glu Ile Leu Leu Gln Cys Ala Leu Lys Ala Ala | |
| 215 220 225 | |
| ggc aga cag cac gat gcg ttt ggc aag cgt gct aaa aac acg ctt ctc | 835 |
| Gly Arg Gln His Asp Ala Phe Gly Lys Arg Ala Lys Asn Thr Leu Leu | |
| 230 235 240 245 | |
| gac gaa tcc cgc aac gcg aag gaa gct ctt gtt ccg caa tcc cgt cgc | 883 |
| Asp Glu Ser Arg Asn Ala Lys Glu Ala Leu Val Pro Gln Ser Arg Arg | |
| 250 255 260 | |
| ttg gtt cta gaa att ggc gac gac gac atc acc gtt cca gtg aac aag | 931 |
| Leu Val Leu Glu Ile Gly Asp Asp Asp Ile Thr Val Pro Val Asn Lys | |
| 265 270 275 | |
| ttc tac gag gct gcc act ccc ctg gtg gaa aaa tcc ttg tcc atc atg | 979 |
| Phe Tyr Glu Ala Ala Thr Pro Leu Val Glu Lys Ser Leu Ser Ile Met | |
| 280 285 290 | |
| gaa ccc ctc atc ggc gtc gat gat ctt aaa gat tcc gac atc gca ggc | 1027 |
| Glu Pro Leu Ile Gly Val Asp Asp Leu Lys Asp Ser Asp Ile Ala Gly | |
| 295 300 305 | |
| atc tac ctt gtt ggt gga gga tcc tcg ctc cca ctc gtt tcc agg ttg | 1075 |
| Ile Tyr Leu Val Gly Gly Gly Ser Ser Leu Pro Leu Val Ser Arg Leu | |
| 310 315 320 325 | |
| ctc cgc gag cgt ttc ggc cgc cgt gtc cac cgc tcc cca ttc ccc tca | 1123 |
| Leu Arg Glu Arg Phe Gly Arg Arg Val His Arg Ser Pro Phe Pro Ser | |
| 330 335 340 | |

ggt tcc act gcg gtg ggt ctg gcc atc gcg gct gac cct tcc tct ggt 1171
 Gly Ser Thr Ala Val Gly Leu Ala Ile Ala Ala Asp Pro Ser Ser Gly
 345 350 355

ttc cac cta agg gac cgc gtt gcg cga ggc atc ggt gtg ttc cgt gag 1219
 Phe His Leu Arg Asp Arg Val Ala Arg Gly Ile Gly Val Phe Arg Glu
 360 365 370

cac gat tct ggt cgt gcc gtg agc ttt gac ccg ctg atc gcc ccg gac 1267
 His Asp Ser Gly Arg Ala Val Ser Phe Asp Pro Leu Ile Ala Pro Asp
 375 380 385

<210> 26
 <211> 389
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 26
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 20 25 30

Asp Thr His Asp Phe Ile Pro Ser Val Val Ala Leu Lys Ala Asp Arg
 35 40 45

Ile Val Ala Gly Trp Asp Ala Ile Glu Val Gly Gln Asp His Pro Ser
 50 55 60

Phe Val Arg Ser Phe Lys Arg Leu Leu Ser Glu Pro Asn Val Thr Glu
 65 70 75 80

Ala Thr Pro Val Tyr Leu Gly Asp His Val His Pro Leu Gly Ala Val
 85 90 95

Leu Glu Ala Phe Ala Glu Asn Val Val Thr Ala Leu Arg Ala Phe Gln
 100 105 110

Thr Gln Leu Gly Asp Thr Ser Pro Ile Glu Val Val Ile Gly Val Pro
 115 120 125

Ala Asn Ser His Ser Ala Gln Arg Leu Leu Thr Met Ser Ala Phe Ser
 130 135 140

Ala Thr Gly Ile Thr Val Val Gly Leu Val Asn Glu Pro Ser Ala Ala
 145 150 155 160

Ala Phe Glu Tyr Thr His Arg His Ala Arg Thr Leu Asn Ser Lys Arg
 165 170 175

Gln Ala Ile Val Val Tyr Asp Leu Gly Gly Gly Thr Phe Asp Ser Ser
 180 185 190

Leu Ile Arg Ile Asp Gly Thr His His Glu Val Val Ser Ser Ile Gly
 195 200 205

Ile Ser Arg Leu Gly Gly Asp Asp Phe Asp Glu Ile Leu Leu Gln Cys
 210 215 220
 Ala Leu Lys Ala Ala Gly Arg Gln His Asp Ala Phe Gly Lys Arg Ala
 225 230 235 240
 Lys Asn Thr Leu Leu Asp Glu Ser Arg Asn Ala Lys Glu Ala Leu Val
 245 250 255
 Pro Gln Ser Arg Arg Leu Val Leu Glu Ile Gly Asp Asp Asp Ile Thr
 260 265 270
 Val Pro Val Asn Lys Phe Tyr Glu Ala Ala Thr Pro Leu Val Glu Lys
 275 280 285
 Ser Leu Ser Ile Met Glu Pro Leu Ile Gly Val Asp Asp Leu Lys Asp
 290 295 300
 Ser Asp Ile Ala Gly Ile Tyr Leu Val Gly Gly Gly Ser Ser Leu Pro
 305 310 315 320
 Leu Val Ser Arg Leu Leu Arg Glu Arg Phe Gly Arg Arg Val His Arg
 325 330 335
 Ser Pro Phe Pro Ser Gly Ser Thr Ala Val Gly Leu Ala Ile Ala Ala
 340 345 350
 Asp Pro Ser Ser Gly Phe His Leu Arg Asp Arg Val Ala Arg Gly Ile
 355 360 365
 Gly Val Phe Arg Glu His Asp Ser Gly Arg Ala Val Ser Phe Asp Pro
 370 375 380
 Leu Ile Ala Pro Asp
 385

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 <223> RXA02541

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 attcaccgca tataagactc atggaaggag gggatgccca gtg aac aac agc gaa 115
 Val Asn Asn Ser Glu
 1 5
 tgg gca aat aag aac tat tac gca gac ctg ggg gtc tcc tcg tcc gct 163
 Trp Ala Asn Lys Asn Tyr Tyr Ala Asp Leu Gly Val Ser Ser Ser Ala

| | 10 | 15 | 20 | |
|---|-----|-----|-----|-----|
| tca gaa gat gag atc aaa aag gct tac cgc aag ctc gcc agg gaa aat | | | | 211 |
| Ser Glu Asp Glu Ile Lys Lys Ala Tyr Arg Lys Leu Ala Arg Glu Asn | | | | |
| | 25 | 30 | 35 | |
| cac cca gat aaa aat cca ggt gac aag gcc gct gaa gat cga ttc aaa | | | | 259 |
| His Pro Asp Lys Asn Pro Gly Asp Lys Ala Ala Glu Asp Arg Phe Lys | | | | |
| | 40 | 45 | 50 | |
| aaa gcg gcc gag gca tat gac gta ctt ggt gat gac aag aaa cga aaa | | | | 307 |
| Lys Ala Ala Glu Ala Tyr Asp Val Leu Gly Asp Asp Lys Lys Arg Lys | | | | |
| | 55 | 60 | 65 | |
| gaa tac gac gag ctc aaa gca ctt cta gct tct ggt gga atc cgc gga | | | | 355 |
| Glu Tyr Asp Glu Leu Lys Ala Leu Leu Ala Ser Gly Gly Ile Arg Gly | | | | |
| | 70 | 75 | 80 | 85 |
| gga ttc gga agc gga ggt gcg gga ttc ccc gcc ggg ttt cgc acg tcg | | | | 403 |
| Gly Phe Gly Ser Gly Gly Ala Gly Phe Pro Gly Gly Phe Arg Thr Ser | | | | |
| | 90 | 95 | 100 | |
| acg gga gga ttc gac acc tca gac ctc ttc gga gga gga caa ggt gga | | | | 451 |
| Thr Gly Gly Phe Asp Thr Ser Asp Leu Phe Gly Gly Gly Gln Gly Gly | | | | |
| | 105 | 110 | 115 | |
| ggg ttt tct acg gac gcc ggt ttg gcc gat atc ttc ggt gcc ctt ttc | | | | 499 |
| Gly Phe Ser Thr Asp Gly Gly Leu Gly Asp Ile Phe Gly Gly Leu Phe | | | | |
| | 120 | 125 | 130 | |
| aac cgc gcc gct ggt tct cac cag tca gct agg ccg acg cgg ggg gcg | | | | 547 |
| Asn Arg Gly Ala Gly Ser His Gln Ser Ala Arg Pro Thr Arg Gly Ala | | | | |
| | 135 | 140 | 145 | |
| gat gta caa acc gaa ata act ctc tcg ttt gtt gag gca gcg aaa gcc | | | | 595 |
| Asp Val Gln Thr Glu Ile Thr Leu Ser Phe Val Glu Ala Ala Lys Gly | | | | |
| | 150 | 155 | 160 | 165 |
| acg acc atc cca gtg gaa ctc acc gcc gat gcg ccc tgc aac acc tgc | | | | 643 |
| Thr Thr Ile Pro Val Glu Leu Thr Gly Asp Ala Pro Cys Asn Thr Cys | | | | |
| | 170 | 175 | 180 | |
| cac gga tcg gcc tcc aaa tca gcc cac ccc gca aaa tgt gga acc tgt | | | | 691 |
| His Gly Ser Gly Ser Lys Ser Gly His Pro Ala Lys Cys Gly Thr Cys | | | | |
| | 185 | 190 | 195 | |
| gat gga acc gga ttc acc tct gag aac aag ggt gct ttc gga ttc tcc | | | | 739 |
| Asp Gly Thr Gly Phe Thr Ser Glu Asn Lys Gly Ala Phe Gly Phe Ser | | | | |
| | 200 | 205 | 210 | |
| gct cca tgt gca acc tgt ggt gcc act ggt gaa ata atc act gat cct | | | | 787 |
| Ala Pro Cys Ala Thr Cys Gly Gly Thr Gly Glu Ile Ile Thr Asp Pro | | | | |
| | 215 | 220 | 225 | |
| tgc gat aac tgc cac gcc cga gcc acc gtc cgg aag tct cgt tcc atc | | | | 835 |
| Cys Asp Asn Cys His Gly Arg Gly Thr Val Arg Lys Ser Arg Ser Ile | | | | |
| | 230 | 235 | 240 | 245 |

acc gtg cgt atc cca act ggt gtg gaa gat gga cag aaa gtt cgt ctt 883
 Thr Val Arg Ile Pro Thr Gly Val Glu Asp Gly Gln Lys Val Arg Leu
 250 255 260

gca ggc caa ggc gaa gca gga cca aat ggc aaa cca gcg ggc gat ctc 931
 Ala Gly Gln Gly Glu Ala Gly Pro Asn Gly Lys Pro Ala Gly Asp Leu
 265 270 275

ttt gtg aaa gtc cac gtg aaa aag gac gat gtg ttc aca cgc gac ggc 979
 Phe Val Lys Val His Val Lys Lys Asp Asp Val Phe Thr Arg Asp Gly
 280 285 290

agc aac att ttg atc acc att ccc gtg agc ttc agc gag ctg gct ttg 1027
 Ser Asn Ile Leu Ile Thr Ile Pro Val Ser Phe Ser Glu Leu Ala Leu
 295 300 305

ggt ggc gct att tct gtg cca acg ctc aac aag cct gta aaa ctc aag 1075
 Gly Gly Ala Ile Ser Val Pro Thr Leu Asn Lys Pro Val Lys Leu Lys
 310 315 320 325

cta cct gcg gga acg cca gat ggt cgt act ttg cgt gta cgc ggt cgc 1123
 Leu Pro Ala Gly Thr Pro Asp Gly Arg Thr Leu Arg Val Arg Gly Arg
 330 335 340

ggt atc gaa gca cgt gat tcc act ggt gat ctg ctg gtt aca gtc cag 1171
 Gly Ile Glu Ala Arg Asp Ser Thr Gly Asp Leu Leu Val Thr Val Gln
 345 350 355

gtt tct gtc ccg aag aat ctg gat gac aac gct gcg gaa gct ctc cgc 1219
 Val Ser Val Pro Lys Asn Leu Asp Asp Asn Ala Ala Glu Ala Leu Arg
 360 365 370

gca tat gct gaa gca gaa act aat tca ggt ttt gat ccc cgc gct aac 1267
 Ala Tyr Ala Glu Ala Glu Thr Asn Ser Gly Phe Asp Pro Arg Ala Asn
 375 380 385

tgg gcg ggc cag aac cgc tagacgttct ctttgagaaa gga 1308
 Trp Ala Gly Gln Asn Arg
 390 395

<210> 28

<211> 395

<212> PRT

<213> Corynebacterium glutamicum

<400> 28

Val Asn Asn Ser Glu Trp Ala Asn Lys Asn Tyr Tyr Ala Asp Leu Gly
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Val Ser Ser Ser Ala Ser Glu Asp Glu Ile Lys Lys Ala Tyr Arg Lys
 20 25 30

Leu Ala Arg Glu Asn His Pro Asp Lys Asn Pro Gly Asp Lys Ala Ala
 35 40 45

Glu Asp Arg Phe Lys Lys Ala Ala Glu Ala Tyr Asp Val Leu Gly Asp
 50 \ 55 60
 Asp Lys Lys Arg Lys Glu Tyr Asp Glu Leu Lys Ala Leu Leu Ala Ser
 65 70 75 80
 Gly Gly Ile Arg Gly Gly Phe Gly Ser Gly Gly Ala Gly Phe Pro Gly
 85 90 95
 Gly Phe Arg Thr Ser Thr Gly Gly Phe Asp Thr Ser Asp Leu Phe Gly
 100 105 110
 Gly Gly Gln Gly Gly Gly Phe Ser Thr Asp Gly Gly Leu Gly Asp Ile
 115 120 125
 Phe Gly Gly Leu Phe Asn Arg Gly Ala Gly Ser His Gln Ser Ala Arg
 130 135 140
 Pro Thr Arg Gly Ala Asp Val Gln Thr Glu Ile Thr Leu Ser Phe Val
 145 150 155 160
 Glu Ala Ala Lys Gly Thr Thr Ile Pro Val Glu Leu Thr Gly Asp Ala
 165 170 175
 Pro Cys Asn Thr Cys His Gly Ser Gly Ser Lys Ser Gly His Pro Ala
 180 185 190
 Lys Cys Gly Thr Cys Asp Gly Thr Gly Phe Thr Ser Glu Asn Lys Gly
 195 200 205
 Ala Phe Gly Phe Ser Ala Pro Cys Ala Thr Cys Gly Gly Thr Gly Glu
 210 215 220
 Ile Ile Thr Asp Pro Cys Asp Asn Cys His Gly Arg Gly Thr Val Arg
 225 230 235 240
 Lys Ser Arg Ser Ile Thr Val Arg Ile Pro Thr Gly Val Glu Asp Gly
 245 250 255
 Gln Lys Val Arg Leu Ala Gly Gln Gly Glu Ala Gly Pro Asn Gly Lys
 260 265 270
 Pro Ala Gly Asp Leu Phe Val Lys Val His Val Lys Lys Asp Asp Val
 275 280 285
 Phe Thr Arg Asp Gly Ser Asn Ile Leu Ile Thr Ile Pro Val Ser Phe
 290 295 300
 Ser Glu Leu Ala Leu Gly Gly Ala Ile Ser Val Pro Thr Leu Asn Lys
 305 310 315 320
 Pro Val Lys Leu Lys Leu Pro Ala Gly Thr Pro Asp Gly Arg Thr Leu
 325 330 335
 Arg Val Arg Gly Arg Gly Ile Glu Ala Arg Asp Ser Thr Gly Asp Leu
 340 345 350

Leu Val Thr Val Gln Val Ser Val Pro Lys Asn Leu Asp Asp Asn Ala
 355 360 365

Ala Glu Ala Leu Arg Ala Tyr Ala Glu Ala Glu Thr Asn Ser Gly Phe
 370 375 380

Asp Pro Arg Ala Asn Trp Ala Gly Gln Asn Arg
 385 390 395

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<211> 777

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(754)

<223> RXA02542

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cgaagacgac gcagctgaca atggtgagga caagaagtaa atg act acc cct aac 115
 Met Thr Thr Pro Asn
 1 5

gga atg ccc gac aat cct ggg gat cct gaa aat acc gat cca gag gca 163
 Gly Met Pro Asp Asn Pro Gly Asp Pro Glu Asn Thr Asp Pro Glu Ala
 10 15 20

acc tct gct gat cgt gct gag cag gca gct gaa gaa gca gct gcc cgc 211
 Thr Ser Ala Asp Arg Ala Glu Gln Ala Ala Glu Glu Ala Ala Ala Arg
 25 30 35

caa gcg gag gaa tct cca ttt gga cag gcc tca gag gaa gaa att tct 259
 Gln Ala Glu Glu Ser Pro Phe Gly Gln Ala Ser Glu Glu Glu Ile Ser
 40 45 50

cca gag ctc gaa gca gag atc aat gat ctt cta tca gat gtt gat cca 307
 Pro Glu Leu Glu Ala Glu Ile Asn Asp Leu Leu Ser Asp Val Asp Pro
 55 60 65

gat ttg gat ggc gat ggt gaa gtg tcc gct gta gaa aca cag ctt gcc 355
 Asp Leu Asp Gly Asp Gly Glu Val Ser Ala Val Glu Thr Gln Leu Ala
 70 75 80 85

gaa cgc act gag gat ctg cag cga gtc acc gct gag tac gcc aac tac 403
 Glu Arg Thr Glu Asp Leu Gln Arg Val Thr Ala Glu Tyr Ala Asn Tyr
 90 95 100

cgt cga cgt acc gag cgt gaa cgc cag ggc atc atc gac acc gca cgc 451
 Arg Arg Arg Thr Glu Arg Glu Arg Gln Gly Ile Ile Asp Thr Ala Arg
 105 110 115

gca ggt gtt gtt acc caa ctt ctg ccg ttg ctc gac gat ctt gac ctg 499
 Ala Gly Val Val Thr Gln Leu Leu Pro Leu Leu Asp Asp Leu Asp Leu

| 120 | 125 | 130 | |
|---|-----|-----|-----|
| gct gaa cag cac ggt gac ctt aac gaa ggt ccg ctg aag tca ctg tct | | | 547 |
| Ala Glu Gln His Gly Asp Leu Asn Glu Gly Pro Leu Lys Ser Leu Ser | | | |
| 135 | 140 | 145 | |
| gac aag ctg atc aac atc ctg ggt gga ttg aag gtg gaa tcc ttc ggc | | | 595 |
| Asp Lys Leu Ile Asn Ile Leu Gly Gly Leu Lys Val Glu Ser Phe Gly | | | |
| 150 | 155 | 160 | 165 |
| gag atc ggc gaa gca ttc gat cca gag atc cac gaa gca gta cag gat | | | 643 |
| Glu Ile Gly Glu Ala Phe Asp Pro Glu Ile His Glu Ala Val Gln Asp | | | |
| 170 | 175 | 180 | |
| ctc tca cag ggt gat gtc aag gtt ctg gga acg gta ctc cgc aag gga | | | 691 |
| Leu Ser Gln Gly Asp Val Lys Val Leu Gly Thr Val Leu Arg Lys Gly | | | |
| 185 | 190 | 195 | |
| tac cgc ctc ggc gac cgc gtc atc cgc acc gca atg gtc ctc att ggg | | | 739 |
| Tyr Arg Leu Gly Asp Arg Val Ile Arg Thr Ala Met Val Leu Ile Gly | | | |
| 200 | 205 | 210 | |
| gat cca gag gag agc tagagagact aagtctctta gtg | | | 777 |
| Asp Pro Glu Glu Ser | | | |
| 215 | | | |

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 <213> Corynebacterium glutamicum

<400> 30
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 Glu Ala Ala Ala Arg Gln Ala Glu Glu Ser Pro Phe Gly Gln Ala Ser
 35 40 45
 Glu Glu Glu Ile Ser Pro Glu Leu Glu Ala Glu Ile Asn Asp Leu Leu
 50 55 60
 Ser Asp Val Asp Pro Asp Leu Asp Gly Asp Gly Glu Val Ser Ala Val
 65 70 75 80
 Glu Thr Gln Leu Ala Glu Arg Thr Glu Asp Leu Gln Arg Val Thr Ala
 85 90 95
 Glu Tyr Ala Asn Tyr Arg Arg Arg Thr Glu Arg Glu Arg Gln Gly Ile
 100 105 110
 Ile Asp Thr Ala Arg Ala Gly Val Val Thr Gln Leu Leu Pro Leu Leu
 115 120 125

Asp Asp Leu Asp Leu Ala Glu Gln His Gly Asp Leu Asn Glu Gly Pro
 130 135 140
 Leu Lys Ser Leu Ser Asp Lys Leu Ile Asn Ile Leu Gly Gly Leu Lys
 145 150 155 160
 Val Glu Ser Phe Gly Glu Ile Gly Glu Ala Phe Asp Pro Glu Ile His
 165 170 175
 Glu Ala Val Gln Asp Leu Ser Gln Gly Asp Val Lys Val Leu Gly Thr
 180 185 190
 Val Leu Arg Lys Gly Tyr Arg Leu Gly Asp Arg Val Ile Arg Thr Ala
 195 200 205
 Met Val Leu Ile Gly Asp Pro Glu Glu Ser
 210 215

<210> 31
 <211> 1977
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(1954)
 <223> RXN02543

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 Met Gly Arg Ala Val
 1 5
 gga att gac ctt gga acc acc aac tct gtg gtt tcc gta ctt gaa ggc 163
 Gly Ile Asp Leu Gly Thr Thr Asn Ser Val Val Ser Val Leu Glu Gly
 10 15 20
 ggc gag cca gta gtt atc gca aac gca gaa ggc tca cgc acc acc cct 211
 Gly Glu Pro Val Val Ile Ala Asn Ala Glu Gly Ser Arg Thr Thr Pro
 25 30 35
 tcc gtc gtt gca ttc gca aag aac ggt gaa gtt cta gtc ggc cag tcc 259
 Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val Leu Val Gly Gln Ser
 40 45 50
 gct aag aac cag gcg gtc acc aac gtt gac cgc acc att cgc tcc gtc 307
 Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg Thr Ile Arg Ser Val
 55 60 65
 aag cgc cac atc ggc acc gac tgg tcc gtt gct atc gat gac aag aac 355
 Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala Ile Asp Asp Lys Asn
 70 75 80 85
 tac acc tca cag gaa atc tcg gct cgt acc ctg atg aag ctg aag cgc 403

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Tyr | Thr | Ser | Gln | Glu | Ile | Ser | Ala | Arg | Thr | Leu | Met | Lys | Leu | Lys | Arg | |
| | | | | 90 | | | | | 95 | | | | | | 100 | |
| gac | gct | gaa | gca | tac | ctg | ggc | gag | gac | gtc | act | gat | gct | gtt | att | acc | 451 |
| Asp | Ala | Glu | Ala | Tyr | Leu | Gly | Glu | Asp | Val | Thr | Asp | Ala | Val | Ile | Thr | |
| | | | 105 | | | | | 110 | | | | | 115 | | | |
| gtt | cct | gca | tac | ttc | gag | gac | tca | cag | cgc | cag | gca | acc | aag | gaa | gct | 499 |
| Val | Pro | Ala | Tyr | Phe | Glu | Asp | Ser | Gln | Arg | Gln | Ala | Thr | Lys | Glu | Ala | |
| | | | 120 | | | | | 125 | | | | | 130 | | | |
| ggt | cag | atc | gca | ggc | ctt | aac | gtt | ctg | cgt | att | gtt | aac | gag | cca | acc | 547 |
| Gly | Gln | Ile | Ala | Gly | Leu | Asn | Val | Leu | Arg | Ile | Val | Asn | Glu | Pro | Thr | |
| | | | 135 | | | | | 140 | | | | 145 | | | | |
| gcg | gct | gca | ctt | gca | tac | ggc | ctt | gag | aag | ggc | gag | cag | gag | cag | acc | 595 |
| Ala | Ala | Ala | Leu | Ala | Tyr | Gly | Leu | Glu | Lys | Gly | Glu | Gln | Glu | Gln | Thr | |
| | | | 150 | | | | 155 | | | | 160 | | | | 165 | |
| att | ctg | gta | ttc | gac | ctc | ggt | ggc | ggc | acc | ttc | gac | gtc | tcc | ctc | cta | 643 |
| Ile | Leu | Val | Phe | Asp | Leu | Gly | Gly | Gly | Thr | Phe | Asp | Val | Ser | Leu | Leu | |
| | | | | 170 | | | | | 175 | | | | | | 180 | |
| gag | atc | ggc | gac | ggt | gtt | gtt | gag | gtt | cgc | gca | acc | tcc | ggc | gat | aac | 691 |
| Glu | Ile | Gly | Asp | Gly | Val | Val | Glu | Val | Arg | Ala | Thr | Ser | Gly | Asp | Asn | |
| | | | 185 | | | | | 190 | | | | | 195 | | | |
| gag | ctc | ggt | ggc | gac | gac | tgg | gat | cag | cgt | atc | gtt | gac | tgg | ctg | gta | 739 |
| Glu | Leu | Gly | Gly | Asp | Asp | Trp | Asp | Gln | Arg | Ile | Val | Asp | Trp | Leu | Val | |
| | | | 200 | | | | | 205 | | | | | 210 | | | |
| gag | aag | ttc | cag | tcc | tcc | aac | ggc | att | gac | ctg | acc | aag | gac | aag | atg | 787 |
| Glu | Lys | Phe | Gln | Ser | Ser | Asn | Gly | Ile | Asp | Leu | Thr | Lys | Asp | Lys | Met | |
| | | | 215 | | | | 220 | | | | 225 | | | | | |
| gcc | ctg | cag | cgt | ctg | cgt | gag | gca | gct | gag | aag | gca | aag | atc | gag | ctg | 835 |
| Ala | Leu | Gln | Arg | Leu | Arg | Glu | Ala | Ala | Glu | Lys | Ala | Lys | Ile | Glu | Leu | |
| | | | | | | 235 | | | | | 240 | | | | 245 | |
| tcc | tct | tcc | cag | agt | gca | aac | atc | aac | ctt | cct | tac | atc | acc | gtt | gat | 883 |
| Ser | Ser | Ser | Gln | Ser | Ala | Asn | Ile | Asn | Leu | Pro | Tyr | Ile | Thr | Val | Asp | |
| | | | | 250 | | | | | 255 | | | | | | 260 | |
| gca | gac | aag | aac | cca | ctg | ttc | ttg | gat | gag | acc | ctt | tcc | cgt | gcc | gag | 931 |
| Ala | Asp | Lys | Asn | Pro | Leu | Phe | Leu | Asp | Glu | Thr | Leu | Ser | Arg | Ala | Glu | |
| | | | 265 | | | | | 270 | | | | | 275 | | | |
| ttc | cag | cgc | atc | acc | cag | gac | ctc | ctg | gcc | cgc | acc | aag | act | cct | ttc | 979 |
| Phe | Gln | Arg | Ile | Thr | Gln | Asp | Leu | Leu | Ala | Arg | Thr | Lys | Thr | Pro | Phe | |
| | | | 280 | | | | | 285 | | | | | 290 | | | |
| aac | cag | gtt | gtt | aag | gac | gct | ggc | gtg | tcc | gtc | tcg | gag | atc | gac | cac | 1027 |
| Asn | Gln | Val | Val | Lys | Asp | Ala | Gly | Val | Ser | Val | Ser | Glu | Ile | Asp | His | |
| | | | 295 | | | | 300 | | | | 305 | | | | | |
| gtt | gtt | ctc | gtc | ggt | ggt | tcc | acc | cgt | atg | cct | gct | gtt | acc | gaa | ctg | 1075 |
| Val | Val | Leu | Val | Gly | Gly | Ser | Thr | Arg | Met | Pro | Ala | Val | Thr | Glu | Leu | |

| 310 | 315 | 320 | 325 | |
|---|-----|-----|-----|------|
| gtc aag gaa ctg acc ggt gga cgt gag cca aac aag ggt gtt aac cca | | | | 1123 |
| Val Lys Glu Leu Thr Gly Gly Arg Glu Pro Asn Lys Gly Val Asn Pro | | | | |
| 330 | | 335 | 340 | |
| gat gag gtt gtt gca gtt ggt gca gca ctt cag gcc ggt gtt ctc cgc | | | | 1171 |
| Asp Glu Val Val Ala Val Gly Ala Ala Leu Gln Ala Gly Val Leu Arg | | | | |
| 345 | | 350 | 355 | |
| ggc gag gtc aag gat gtt ctt ctt ctt gac gtc acc cca ctg tcc ctc | | | | 1219 |
| Gly Glu Val Lys Asp Val Leu Leu Leu Asp Val Thr Pro Leu Ser Leu | | | | |
| 360 | | 365 | 370 | |
| ggc att gag acc aag ggt ggc gtg atg acc aag ctc atc gag cgc aac | | | | 1267 |
| Gly Ile Glu Thr Lys Gly Gly Val Met Thr Lys Leu Ile Glu Arg Asn | | | | |
| 375 | | 380 | 385 | |
| acc acc atc cct acc aag cgt tcc gag acc ttc acc acc gca gag gac | | | | 1315 |
| Thr Thr Ile Pro Thr Lys Arg Ser Glu Thr Phe Thr Thr Ala Glu Asp | | | | |
| 390 | | 395 | 400 | 405 |
| aac cag cct tct gtt cag atc cag gtc ttc cag ggc gag cgt gaa atc | | | | 1363 |
| Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln Gly Glu Arg Glu Ile | | | | |
| 410 | | 415 | 420 | |
| gca acc gcc aac aag ctg ctc gga tcc ttc gag ctc ggc ggc atc gca | | | | 1411 |
| Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu Leu Gly Gly Ile Ala | | | | |
| 425 | | 430 | 435 | |
| cct gca cca cgt ggc gtc cca cag atc gag gtc act ttc gac atc gac | | | | 1459 |
| Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val Thr Phe Asp Ile Asp | | | | |
| 440 | | 445 | 450 | |
| gcc aac ggc atc gtc cac gtc acc gca aag gac aag ggt act ggc aag | | | | 1507 |
| Ala Asn Gly Ile Val His Val Thr Ala Lys Asp Lys Gly Thr Gly Lys | | | | |
| 455 | | 460 | 465 | |
| gaa aac acc atc acc att cag gac ggc tcc ggt ctc tcc cag gat gaa | | | | 1555 |
| Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly Leu Ser Gln Asp Glu | | | | |
| 470 | | 475 | 480 | 485 |
| att gat cgc atg atc aag gat gct gaa gct cac gct gat gag gac aag | | | | 1603 |
| Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His Ala Asp Glu Asp Lys | | | | |
| 490 | | 495 | 500 | |
| aag cgc cgc gag gag cag gaa gtc cgc aac aac gct gag tcc ctg gtt | | | | 1651 |
| Lys Arg Arg Glu Glu Gln Glu Val Arg Asn Asn Ala Glu Ser Leu Val | | | | |
| 505 | | 510 | 515 | |
| tac cag acc cgc aag ttc gtt gaa gag aac tcc gag aag gtc tcc gaa | | | | 1699 |
| Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser Glu Lys Val Ser Glu | | | | |
| 520 | | 525 | 530 | |
| gac ctc aag gca aag gtc gaa gag gca gcc aag ggc gtt gaa gaa gca | | | | 1747 |
| Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys Gly Val Glu Glu Ala | | | | |
| 535 | | 540 | 545 | |

ctc aag ggc gag gac ctc gag gca atc aag gct gca gtt gag aag ctg 1795
 Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala Ala Val Glu Lys Leu
 550 555 560 565

aac acc gag tcc cag gaa atg ggt aag gct atc tac gag gct gac gct 1843
 Asn Thr Glu Ser Gln Glu Met Gly Lys Ala Ile Tyr Glu Ala Asp Ala
 570 575 580

gct gct ggt gca acc cag gct gac gca ggt gca gaa ggc gct gca gat 1891
 Ala Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala Glu Gly Ala Ala Asp
 585 590 595

gac aat gtt gtt gac gct gaa gtt gtc gaa gac gac gca gct gac aat 1939
 Asp Asn Val Val Asp Ala Glu Val Val Glu Asp Asp Ala Ala Asp Asn
 600 605 610

ggt gag gac aag aag taaatgacta cccctaacgg aat 1977
 Gly Glu Asp Lys Lys
 615

<210> 32

<211> 618

<212> PRT

<213> Corynebacterium glutamicum

<400> 32

Met Gly Arg Ala Val Gly Ile Asp Leu Gly Thr Thr Asn Ser Val Val
 1 5 10 15
 Ser Val Leu Glu Gly Gly Glu Pro Val Val Ile Ala Asn Ala Glu Gly
 20 25 30
 Ser Arg Thr Thr Pro Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val
 35 40 45
 Leu Val Gly Gln Ser Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg
 50 55 60
 Thr Ile Arg Ser Val Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala
 65 70 75 80
 Ile Asp Asp Lys Asn Tyr Thr Ser Gln Glu Ile Ser Ala Arg Thr Leu
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 Met Lys Leu Lys Arg Asp Ala Glu Ala Tyr Leu Gly Glu Asp Val Thr
 100 105 110
 Asp Ala Val Ile Thr Val Pro Ala Tyr Phe Glu Asp Ser Gln Arg Gln
 115 120 125
 Ala Thr Lys Glu Ala Gly Gln Ile Ala Gly Leu Asn Val Leu Arg Ile
 130 135 140
 Val Asn Glu Pro Thr Ala Ala Ala Leu Ala Tyr Gly Leu Glu Lys Gly
 145 150 155 160

Glu Gln Glu Gln Thr Ile Leu Val Phe Asp Leu Gly Gly Gly Thr Phe
 165 170 175
 Asp Val Ser Leu Leu Glu Ile Gly Asp Gly Val Val Glu Val Arg Ala
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 Thr Ser Gly Asp Asn Glu Leu Gly Gly Asp Asp Trp Asp Gln Arg Ile
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 Val Asp Trp Leu Val Glu Lys Phe Gln Ser Ser Asn Gly Ile Asp Leu
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 Thr Lys Asp Lys Met Ala Leu Gln Arg Leu Arg Glu Ala Ala Glu Lys
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 Ala Lys Ile Glu Leu Ser Ser Ser Gln Ser Ala Asn Ile Asn Leu Pro
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 Leu Ser Arg Ala Glu Phe Gln Arg Ile Thr Gln Asp Leu Leu Ala Arg
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 Thr Lys Thr Pro Phe Asn Gln Val Val Lys Asp Ala Gly Val Ser Val
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 Ser Glu Ile Asp His Val Val Leu Val Gly Gly Ser Thr Arg Met Pro
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 Ala Val Thr Glu Leu Val Lys Glu Leu Thr Gly Gly Arg Glu Pro Asn
 325 330 335
 Lys Gly Val Asn Pro Asp Glu Val Val Ala Val Gly Ala Ala Leu Gln
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 Ala Gly Val Leu Arg Gly Glu Val Lys Asp Val Leu Leu Leu Asp Val
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 Thr Pro Leu Ser Leu Gly Ile Glu Thr Lys Gly Gly Val Met Thr Lys
 370 375 380
 Leu Ile Glu Arg Asn Thr Thr Ile Pro Thr Lys Arg Ser Glu Thr Phe
 385 390 395 400
 Thr Thr Ala Glu Asp Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln
 405 410 415
 Gly Glu Arg Glu Ile Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu
 420 425 430
 Leu Gly Gly Ile Ala Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val
 435 440 445
 Thr Phe Asp Ile Asp Ala Asn Gly Ile Val His Val Thr Ala Lys Asp
 450 455 460

Lys Gly Thr Gly Lys Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly
465 470 475 480

Leu Ser Gln Asp Glu Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His
485 490 495

Ala Asp Glu Asp Lys Lys Arg Arg Glu Glu Gln Glu Val Arg Asn Asn
500 505 510

Ala Glu Ser Leu Val Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser
515 520 525

Glu Lys Val Ser Glu Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys
530 535 540

Gly Val Glu Glu Ala Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala
545 550 555 560

Ala Val Glu Lys Leu Asn Thr Glu Ser Gln Glu Met Gly Lys Ala Ile
565 570 575

Tyr Glu Ala Asp Ala Ala Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala
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Glu Gly Ala Ala Asp Asp Asn Val Val Asp Ala Glu Val Val Glu Asp
595 600 605

Asp Ala Ala Asp Asn Gly Glu Asp Lys Lys
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<210> 33

<211> 1977

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1954)

<223> FRXA02543

<400> 33

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Met Gly Arg Ala Val
1 5

gga att gac ctt gga acc acc aac tct gtg gtt tcc gta ctt gaa ggc 163
Gly Ile Asp Leu Gly Thr Thr Asn Ser Val Val Ser Val Leu Glu Gly
10 15 20

ggc gag cca gta gtt atc gca aac gca gaa ggc tca cgc acc acc cct 211
Gly Glu Pro Val Val Ile Ala Asn Ala Glu Gly Ser Arg Thr Thr Pro
25 30 35

| | |
|---|-----|
| tcc gtc gtt gca ttc gca aag aac ggt gaa gtt cta gtc ggc cag tcc | 259 |
| Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val Leu Val Gly Gln Ser | |
| 40 45 50 | |
| gct aag aac cag gcg gtc acc aac gtt gac cgc acc att cgc tcc gtc | 307 |
| Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg Thr Ile Arg Ser Val | |
| 55 60 65 | |
| aag cgc cac atc ggc acc gac tgg tcc gtt gct atc gat gac aag aac | 355 |
| Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala Ile Asp Asp Lys Asn | |
| 70 75 80 85 | |
| tac acc tca cag gaa atc tcg gct cgt acc ctg atg aag ctg aag cgc | 403 |
| Tyr Thr Ser Gln Glu Ile Ser Ala Arg Thr Leu Met Lys Leu Lys Arg | |
| 90 95 100 | |
| gac gct gaa gca tac ctg ggc gag gac gtc act gat gct gtt att acc | 451 |
| Asp Ala Glu Ala Tyr Leu Gly Glu Asp Val Thr Asp Ala Val Ile Thr | |
| 105 110 115 | |
| gtt cct gca tac ttc gag gac tca cag cgc cag gca acc aag gaa gct | 499 |
| Val Pro Ala Tyr Phe Glu Asp Ser Gln Arg Gln Ala Thr Lys Glu Ala | |
| 120 125 130 | |
| ggt cag atc gca ggc ctt aac gtt ctg cgt att gtt aac gag cca acc | 547 |
| Gly Gln Ile Ala Gly Leu Asn Val Leu Arg Ile Val Asn Glu Pro Thr | |
| 135 140 145 | |
| gcg gct gca ctt gca tac ggc ctt gag aag ggc gag cag gag cag acc | 595 |
| Ala Ala Ala Leu Ala Tyr Gly Leu Glu Lys Gly Glu Gln Glu Gln Thr | |
| 150 155 160 165 | |
| att ctg gta ttc gac ctc ggt ggc ggc acc ttc gac gtc tcc ctc cta | 643 |
| Ile Leu Val Phe Asp Leu Gly Gly Gly Thr Phe Asp Val Ser Leu Leu | |
| 170 175 180 | |
| gag atc ggc gac ggt gtt gtt gag gtt cgc gca acc tcc ggc gat aac | 691 |
| Glu Ile Gly Asp Gly Val Val Glu Val Arg Ala Thr Ser Gly Asp Asn | |
| 185 190 195 | |
| gag ctc ggt ggc gac gac tgg gat cag cgt atc gtt gac tgg ctg gta | 739 |
| Glu Leu Gly Gly Asp Asp Trp Asp Gln Arg Ile Val Asp Trp Leu Val | |
| 200 205 210 | |
| gag aag ttc cag tcc tcc aac ggc att gac ctg acc aag gac aag atg | 787 |
| Glu Lys Phe Gln Ser Ser Asn Gly Ile Asp Leu Thr Lys Asp Lys Met | |
| 215 220 225 | |
| gcc ctg cag cgt ctg cgt gag gca gct gag aag gca aag atc gag ctg | 835 |
| Ala Leu Gln Arg Leu Arg Glu Ala Ala Glu Lys Ala Lys Ile Glu Leu | |
| 230 235 240 245 | |
| tcc tct tcc cag agt gca aac atc aac ctt cct tac atc acc gtt gat | 883 |
| Ser Ser Ser Gln Ser Ala Asn Ile Asn Leu Pro Tyr Ile Thr Val Asp | |
| 250 255 260 | |
| gca gac aag aac cca ctg ttc ttg gat gag acc ctt tcc cgt gcc gag | 931 |

| | |
|---|------|
| Ala Asp Lys Asn Pro Leu Phe Leu Asp Glu Thr Leu Ser Arg Ala Glu | |
| 265 270 275 | |
| ttc cag cgc atc acc cag gac ctc ctg gcc cgc acc aag act cct ttc | 979 |
| Phe Gln Arg Ile Thr Gln Asp Leu Leu Ala Arg Thr Lys Thr Pro Phe | |
| 280 285 290 | |
| aac cag gtt gtt aag gac gct ggc gtg tcc gtc tcg gag atc gac cac | 1027 |
| Asn Gln Val Val Lys Asp Ala Gly Val Ser Val Ser Glu Ile Asp His | |
| 295 300 305 | |
| gtt gtt ctc gtc ggt ggt tcc acc cgt atg cct gct gtt acc gaa ctg | 1075 |
| Val Val Leu Val Gly Gly Ser Thr Arg Met Pro Ala Val Thr Glu Leu | |
| 310 315 320 325 | |
| gtc aag gaa ctg acc ggt gga cgt gag cca aac aag ggt gtt aac cca | 1123 |
| Val Lys Glu Leu Thr Gly Gly Arg Glu Pro Asn Lys Gly Val Asn Pro | |
| 330 335 340 | |
| gat gag gtt gtt gca gtt ggt gca gca ctt cag gcc ggt gtt ctc cgc | 1171 |
| Asp Glu Val Val Ala Val Gly Ala Ala Leu Gln Ala Gly Val Leu Arg | |
| 345 350 355 | |
| ggc gag gtc aag gat gtt ctt ctt ctt gac gtc acc cca ctg tcc ctc | 1219 |
| Gly Glu Val Lys Asp Val Leu Leu Leu Asp Val Thr Pro Leu Ser Leu | |
| 360 365 370 | |
| ggc att gag acc aag ggt ggc gtg atg acc aag ctc atc gag cgc aac | 1267 |
| Gly Ile Glu Thr Lys Gly Gly Val Met Thr Lys Leu Ile Glu Arg Asn | |
| 375 380 385 | |
| acc acc atc cct acc aag cgt tcc gag acc ttc acc acc gca gag gac | 1315 |
| Thr Thr Ile Pro Thr Lys Arg Ser Glu Thr Phe Thr Thr Ala Glu Asp | |
| 390 395 400 405 | |
| aac cag cct tct gtt cag atc cag gtc ttc cag ggc gag cgt gaa atc | 1363 |
| Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln Gly Glu Arg Glu Ile | |
| 410 415 420 | |
| gca acc gcc aac aag ctg ctc gga tcc ttc gag ctc ggc ggc atc gca | 1411 |
| Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu Leu Gly Gly Ile Ala | |
| 425 430 435 | |
| cct gca cca cgt ggc gtc cca cag atc gag gtc act ttc gac atc gac | 1459 |
| Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val Thr Phe Asp Ile Asp | |
| 440 445 450 | |
| gcc aac ggc atc gtc cac gtc acc gca aag gac aag ggt act ggc aag | 1507 |
| Ala Asn Gly Ile Val His Val Thr Ala Lys Asp Lys Gly Thr Gly Lys | |
| 455 460 465 | |
| gaa aac acc atc acc att cag gac ggc tcc ggt ctc tcc cag gat gaa | 1555 |
| Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly Leu Ser Gln Asp Glu | |
| 470 475 480 485 | |
| att gat cgc atg atc aag gat gct gaa gct cac gct gat gag gac aag | 1603 |
| Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His Ala Asp Glu Asp Lys | |

| 490 | 495 | 500 | |
|---|-----|-----|------|
| aag cgc cgc gag gag cag gaa gtc cgc aac aac gct gag tcc ctg gtt | | | 1651 |
| Lys Arg Arg Glu Glu Gln Glu Val Arg Asn Asn Ala Glu Ser Leu Val | | | |
| 505 | 510 | 515 | |
| tac cag acc cgc aag ttc gtt gaa gag aac tcc gag aag gtc tcc gaa | | | 1699 |
| Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser Glu Lys Val Ser Glu | | | |
| 520 | 525 | 530 | |
| gac ctc aag gca aag gtc gaa gag gca gcc aag ggc gtt gaa gaa gca | | | 1747 |
| Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys Gly Val Glu Glu Ala | | | |
| 535 | 540 | 545 | |
| ctc aag ggc gag gac ctc gag gca atc aag gct gca gtt gag aag ctg | | | 1795 |
| Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala Ala Val Glu Lys Leu | | | |
| 550 | 555 | 560 | 565 |
| aac acc gag tcc cag gaa atg ggt aag gnt atc tnc gag gct gac gct | | | 1843 |
| Asn Thr Glu Ser Gln Glu Met Gly Lys Xaa Ile Xaa Glu Ala Asp Ala | | | |
| 570 | 575 | 580 | |
| nct gct ggt gca acc cag gct gac gca ggt gca gaa ggc gct gca gat | | | 1891 |
| Xaa Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala Glu Gly Ala Ala Asp | | | |
| 585 | 590 | 595 | |
| gac aat gtt gtt gac gct gaa gtt gtc gaa gac gac gca gct gac aat | | | 1939 |
| Asp Asn Val Val Asp Ala Glu Val Val Glu Asp Asp Ala Ala Asp Asn | | | |
| 600 | 605 | 610 | |
| ggt gag gac aag aag taaatgacta cccctaacgg aat | | | 1977 |
| Gly Glu Asp Lys Lys | | | |
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<211> 618

<212> PRT

<213> Corynebacterium glutamicum

<400> 34

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| Ser Val Leu Glu Gly Gly Glu Pro Val Val Ile Ala Asn Ala Glu Gly |
| 20 25 30 |

| |
|---|
| Ser Arg Thr Thr Pro Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val |
| 35 40 45 |

| |
|---|
| Leu Val Gly Gln Ser Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg |
| 50 55 60 |

| |
|---|
| Thr Ile Arg Ser Val Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala |
| 65 70 75 80 |

| |
|---|
| Ile Asp Asp Lys Asn Tyr Thr Ser Gln Glu Ile Ser Ala Arg Thr Leu |
|---|

| 85 | | | | | 90 | | | | | 95 | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Lys | Leu | Lys | Arg | Asp | Ala | Glu | Ala | Tyr | Leu | Gly | Glu | Asp | Val | Thr |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Asp | Ala | Val | Ile | Thr | Val | Pro | Ala | Tyr | Phe | Glu | Asp | Ser | Gln | Arg | Gln |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Ala | Thr | Lys | Glu | Ala | Gly | Gln | Ile | Ala | Gly | Leu | Asn | Val | Leu | Arg | Ile |
| | | 130 | | | | 135 | | | | | 140 | | | | |
| Val | Asn | Glu | Pro | Thr | Ala | Ala | Ala | Leu | Ala | Tyr | Gly | Leu | Glu | Lys | Gly |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |
| Glu | Gln | Glu | Gln | Thr | Ile | Leu | Val | Phe | Asp | Leu | Gly | Gly | Gly | Thr | Phe |
| | | | | 165 | | | | | 170 | | | | | 175 | |
| Asp | Val | Ser | Leu | Leu | Glu | Ile | Gly | Asp | Gly | Val | Val | Glu | Val | Arg | Ala |
| | | | 180 | | | | | 185 | | | | | | 190 | |
| Thr | Ser | Gly | Asp | Asn | Glu | Leu | Gly | Gly | Asp | Asp | Trp | Asp | Gln | Arg | Ile |
| | | 195 | | | | | 200 | | | | | 205 | | | |
| Val | Asp | Trp | Leu | Val | Glu | Lys | Phe | Gln | Ser | Ser | Asn | Gly | Ile | Asp | Leu |
| | 210 | | | | | 215 | | | | | 220 | | | | |
| Thr | Lys | Asp | Lys | Met | Ala | Leu | Gln | Arg | Leu | Arg | Glu | Ala | Ala | Glu | Lys |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |
| Ala | Lys | Ile | Glu | Leu | Ser | Ser | Ser | Gln | Ser | Ala | Asn | Ile | Asn | Leu | Pro |
| | | | | 245 | | | | | 250 | | | | | 255 | |
| Tyr | Ile | Thr | Val | Asp | Ala | Asp | Lys | Asn | Pro | Leu | Phe | Leu | Asp | Glu | Thr |
| | | | 260 | | | | | 265 | | | | | 270 | | |
| Leu | Ser | Arg | Ala | Glu | Phe | Gln | Arg | Ile | Thr | Gln | Asp | Leu | Leu | Ala | Arg |
| | | 275 | | | | | 280 | | | | | 285 | | | |
| Thr | Lys | Thr | Pro | Phe | Asn | Gln | Val | Val | Lys | Asp | Ala | Gly | Val | Ser | Val |
| | | 290 | | | | 295 | | | | | 300 | | | | |
| Ser | Glu | Ile | Asp | His | Val | Val | Leu | Val | Gly | Gly | Ser | Thr | Arg | Met | Pro |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 |
| Ala | Val | Thr | Glu | Leu | Val | Lys | Glu | Leu | Thr | Gly | Gly | Arg | Glu | Pro | Asn |
| | | | | 325 | | | | | 330 | | | | | 335 | |
| Lys | Gly | Val | Asn | Pro | Asp | Glu | Val | Val | Ala | Val | Gly | Ala | Ala | Leu | Gln |
| | | | 340 | | | | | 345 | | | | | 350 | | |
| Ala | Gly | Val | Leu | Arg | Gly | Glu | Val | Lys | Asp | Val | Leu | Leu | Leu | Asp | Val |
| | | 355 | | | | | 360 | | | | | 365 | | | |
| Thr | Pro | Leu | Ser | Leu | Gly | Ile | Glu | Thr | Lys | Gly | Gly | Val | Met | Thr | Lys |
| | | 370 | | | | 375 | | | | | 380 | | | | |
| Leu | Ile | Glu | Arg | Asn | Thr | Thr | Ile | Pro | Thr | Lys | Arg | Ser | Glu | Thr | Phe |

| | | | | | | |
|---|--|-----|--|-----|--|-----|
| 385 | | 390 | | 395 | | 400 |
| Thr Thr Ala Glu Asp Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln | | | | | | |
| | | 405 | | 410 | | 415 |
| Gly Glu Arg Glu Ile Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu | | | | | | |
| | | 420 | | 425 | | 430 |
| Leu Gly Gly Ile Ala Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val | | | | | | |
| | | 435 | | 440 | | 445 |
| Thr Phe Asp Ile Asp Ala Asn Gly Ile Val His Val Thr Ala Lys Asp | | | | | | |
| | | 450 | | 455 | | 460 |
| Lys Gly Thr Gly Lys Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly | | | | | | |
| | | 465 | | 470 | | 475 |
| | | | | 475 | | 480 |
| Leu Ser Gln Asp Glu Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His | | | | | | |
| | | 485 | | 490 | | 495 |
| Ala Asp Glu Asp Lys Lys Arg Arg Glu Glu Gln Glu Val Arg Asn Asn | | | | | | |
| | | 500 | | 505 | | 510 |
| Ala Glu Ser Leu Val Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser | | | | | | |
| | | 515 | | 520 | | 525 |
| Glu Lys Val Ser Glu Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys | | | | | | |
| | | 530 | | 535 | | 540 |
| Gly Val Glu Glu Ala Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala | | | | | | |
| | | 545 | | 550 | | 555 |
| | | | | 555 | | 560 |
| Ala Val Glu Lys Leu Asn Thr Glu Ser Gln Glu Met Gly Lys Xaa Ile | | | | | | |
| | | 565 | | 570 | | 575 |
| Xaa Glu Ala Asp Ala Xaa Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala | | | | | | |
| | | 580 | | 585 | | 590 |
| Glu Gly Ala Ala Asp Asp Asn Val Val Asp Ala Glu Val Val Glu Asp | | | | | | |
| | | 595 | | 600 | | 605 |
| Asp Ala Ala Asp Asn Gly Glu Asp Lys Lys | | | | | | |
| | | 610 | | 615 | | |

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<211> 1947

<212> DNA

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<220>

<221> CDS

<222> (101)..(1924)

<223> RXN02280

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| Met Gln Glu Ser Ser | |
| 1 5 | |
| cgt gat aat ttc caa gtt gac ctc ggc ggc gtt gtt gat ctt ttg agt | 163 |
| Arg Asp Asn Phe Gln Val Asp Leu Gly Gly Val Val Asp Leu Leu Ser | |
| 10 15 20 | |
| cgc cac att tat tcc ggt ccg agg gtg tat gtg cgt gag ttg ctg cag | 211 |
| Arg His Ile Tyr Ser Gly Pro Arg Val Tyr Val Arg Glu Leu Leu Gln | |
| 25 30 35 | |
| aat gcg gtt gat gct tgt act gca cgt tct gaa cag ggt gag gag ggc | 259 |
| Asn Ala Val Asp Ala Cys Thr Ala Arg Ser Glu Gln Gly Glu Glu Gly | |
| 40 45 50 | |
| tac gag ccg agt att cgt att ccg ccg gtg acc aag gat cgt gcc acg | 307 |
| Tyr Glu Pro Ser Ile Arg Ile Arg Pro Val Thr Lys Asp Arg Ala Thr | |
| 55 60 65 | |
| ttt tca ctg gtt gat aat ggt acg ggc ctg acc gcg cag gag gcg cgg | 355 |
| Phe Ser Leu Val Asp Asn Gly Thr Gly Leu Thr Ala Gln Glu Ala Arg | |
| 70 75 80 85 | |
| gaa ttg ctg gcg acg gtg ggg ccg acg tcg aaa cgc gat gaa ttc ggt | 403 |
| Glu Leu Leu Ala Thr Val Gly Arg Thr Ser Lys Arg Asp Glu Phe Gly | |
| 90 95 100 | |
| ctg cag ccg gaa ggt cgc ctg ggg caa ttt ggc atc ggg ctg ctt agt | 451 |
| Leu Gln Arg Glu Gly Arg Leu Gly Gln Phe Gly Ile Gly Leu Leu Ser | |
| 105 110 115 | |
| tgt ttc atg gtg gcg gat gag atc acc atg gtg tcg cat gcg gag ggt | 499 |
| Cys Phe Met Val Ala Asp Glu Ile Thr Met Val Ser His Ala Glu Gly | |
| 120 125 130 | |
| gcg tcg gcg att ccg tgg act ggt cat gcg gat ggc acc ttt aac ctg | 547 |
| Ala Ser Ala Ile Arg Trp Thr Gly His Ala Asp Gly Thr Phe Asn Leu | |
| 135 140 145 | |
| gag att ctt ggg gat gac gca acg gat gtc att ccg gtg ggc acg act | 595 |
| Glu Ile Leu Gly Asp Asp Ala Thr Asp Val Ile Pro Val Gly Thr Thr | |
| 150 155 160 165 | |
| gtg cac ctg act ccg cgc cct gat gag cgc acg ttg ctg acg gaa aat | 643 |
| Val His Leu Thr Pro Arg Pro Asp Glu Arg Thr Leu Leu Thr Glu Asn | |
| 170 175 180 | |
| tcc gtg gtc acc att gct agt aat tat ggc cgc tac ctg ccg att cct | 691 |
| Ser Val Val Thr Ile Ala Ser Asn Tyr Gly Arg Tyr Leu Pro Ile Pro | |
| 185 190 195 | |
| att gtg gtg cag ggt gag aaa aac acc acc atc act aca tcg ccg gtg | 739 |
| Ile Val Val Gln Gly Glu Lys Asn Thr Thr Ile Thr Thr Ser Pro Val | |
| 200 205 210 | |

| | |
|---|------|
| ttt gca aag gat act gat cag cag cac agg ctg tat gcc ggc cgg gag | 787 |
| Phe Ala Lys Asp Thr Asp Gln Gln His Arg Leu Tyr Ala Gly Arg Glu | |
| 215 220 225 | |
| cgc ctt ggt aaa act cct ttt gat gtc atc gat ctc acc ggt cct ggc | 835 |
| Arg Leu Gly Lys Thr Pro Phe Asp Val Ile Asp Leu Thr Gly Pro Gly | |
| 230 235 240 245 | |
| atc gag ggt gtg gct tat gta ttg ccg gag gcc cag gct ccg cat atg | 883 |
| Ile Glu Gly Val Ala Tyr Val Leu Pro Glu Ala Gln Ala Pro His Met | |
| 250 255 260 | |
| tcc agg cgt cac agt att tat gtc aac cgc atg ttg gtc tct gat ggg | 931 |
| Ser Arg Arg His Ser Ile Tyr Val Asn Arg Met Leu Val Ser Asp Gly | |
| 265 270 275 | |
| cct tcc acg gtg ctg ccc aac tgg gcg ttc ttt gtg gaa tgt gaa atc | 979 |
| Pro Ser Thr Val Leu Pro Asn Trp Ala Phe Phe Val Glu Cys Glu Ile | |
| 280 285 290 | |
| aat tca acc gat ttg gaa ccc acc gca tcg cgt gaa gcg ctc atg gat | 1027 |
| Asn Ser Thr Asp Leu Glu Pro Thr Ala Ser Arg Glu Ala Leu Met Asp | |
| 295 300 305 | |
| gac acc gcg ttc gcg gca acc agg gaa cat atc ggt gag tgc att aaa | 1075 |
| Asp Thr Ala Phe Ala Ala Thr Arg Glu His Ile Gly Glu Cys Ile Lys | |
| 310 315 320 325 | |
| tcg tgg ctg att aat ctc gcc atg acc aag cct cac cgc gtg cgg gaa | 1123 |
| Ser Trp Leu Ile Asn Leu Ala Met Thr Lys Pro His Arg Val Arg Glu | |
| 330 335 340 | |
| ttt act gcg att cat gat ctt gcc ctg cgc gag ctg tgc caa tcg gac | 1171 |
| Phe Thr Ala Ile His Asp Leu Ala Leu Arg Glu Leu Cys Gln Ser Asp | |
| 345 350 355 | |
| gcg gac ctg gct gaa acc atg ttg ggt ctt ctc acc ttg gag acc tcc | 1219 |
| Ala Asp Leu Ala Glu Thr Met Leu Gly Leu Leu Thr Leu Glu Thr Ser | |
| 360 365 370 | |
| cgt ggt cgc atc tcg atc ggt gag atc acc acg ttg tcc atc acc gag | 1267 |
| Arg Gly Arg Ile Ser Ile Gly Glu Ile Thr Thr Leu Ser Ile Thr Glu | |
| 375 380 385 | |
| gat gtg tcg ctg cag ctg gct acc acg ttg gat gat ttc agg cag ctc | 1315 |
| Asp Val Ser Leu Gln Leu Ala Thr Thr Leu Asp Asp Phe Arg Gln Leu | |
| 390 395 400 405 | |
| aac acc att gcg cgc ccg gac acc ttg att att aat ggc ggc tac att | 1363 |
| Asn Thr Ile Ala Arg Pro Asp Thr Leu Ile Ile Asn Gly Gly Tyr Ile | |
| 410 415 420 | |
| cac gac agc gat ctg gct cgg ctc att ccc gtt cac tac cca ccg ctt | 1411 |
| His Asp Ser Asp Leu Ala Arg Leu Ile Pro Val His Tyr Pro Pro Leu | |
| 425 430 435 | |
| acg gta tct act gct gac ctg cgc gaa tcc atg gat ctg atg gag ctt | 1459 |

| | |
|--|------|
| Thr Val Ser Thr Ala Asp Leu Arg Glu Ser Met Asp Leu Met Glu Leu | |
| 440 445 450 | |
| ccg ccg ctg cag gac att gag aaa gcc aag gca ctg gat gcg cag gtc | 1507 |
| Pro Pro Leu Gln Asp Ile Glu Lys Ala Lys Ala Leu Asp Ala Gln Val | |
| 455 460 465 | |
| acg gaa tca ttg aag gat ttt cag atc aag ggc gca acg agg gtt ttt | 1555 |
| Thr Glu Ser Leu Lys Asp Phe Gln Ile Lys Gly Ala Thr Arg Val Phe | |
| 470 475 480 485 | |
| gaa ccc gca gat gtt cct gcc gtg gtg atc att gat tcc aag gcg cag | 1603 |
| Glu Pro Ala Asp Val Pro Ala Val Val Ile Ile Asp Ser Lys Ala Gln | |
| 490 495 500 | |
| gcc tca cgg gat cgc aat gaa aca caa agc gca acc act gat cgt tgg | 1651 |
| Ala Ser Arg Asp Arg Asn Glu Thr Gln Ser Ala Thr Thr Asp Arg Trp | |
| 505 510 515 | |
| gct gac att ttg gca acg gtg gat aac acg ttg agc cgt caa aca gcc | 1699 |
| Ala Asp Ile Leu Ala Thr Val Asp Asn Thr Leu Ser Arg Gln Thr Ala | |
| 520 525 530 | |
| aac att cca cag gat cag gga ctg tcg gcg ttg tgc ttg aat tgg aac | 1747 |
| Asn Ile Pro Gln Asp Gln Gly Leu Ser Ala Leu Cys Leu Asn Trp Asn | |
| 535 540 545 | |
| aat tcg ctg gtc agg aaa ttg gcg tcc act gat gac acc gcc gtg gtg | 1795 |
| Asn Ser Leu Val Arg Lys Leu Ala Ser Thr Asp Asp Thr Ala Val Val | |
| 550 555 560 565 | |
| tcg cgc acg gtg cgt ttg ctc tac gtt cag gca ttg ttg tcc agc aag | 1843 |
| Ser Arg Thr Val Arg Leu Leu Tyr Val Gln Ala Leu Leu Ser Ser Lys | |
| 570 575 580 | |
| agg cca ctg cgg gtg aag gaa cgc gcg ctg ctt aat gat tcg ctg gca | 1891 |
| Arg Pro Leu Arg Val Lys Glu Arg Ala Leu Leu Asn Asp Ser Leu Ala | |
| 585 590 595 | |
| gat ctg gtt tct ttg tct ttg tca tcc gat atc taagacaatc ctccgcta | 1944 |
| Asp Leu Val Ser Leu Ser Leu Ser Ser Asp Ile | |
| 600 605 | |
| ctt | 1947 |
| <p><210> 36</p> <p><211> 608</p> <p><212> PRT</p> <p><213> <i>Corynebacterium glutamicum</i></p> | |
| <p><400> 36</p> <p>Met Gln Glu Ser Ser Arg Asp Asn Phe Gln Val Asp Leu Gly Gly Val</p> <p>1 5 10 15</p> <p>Val Asp Leu Leu Ser Arg His Ile Tyr Ser Gly Pro Arg Val Tyr Val</p> <p>20 25 30</p> | |

Arg Glu Leu Leu Gln Asn Ala Val Asp Ala Cys Thr Ala Arg Ser Glu
 35 40 45
 Gln Gly Glu Glu Gly Tyr Glu Pro Ser Ile Arg Ile Arg Pro Val Thr
 50 55 60
 Lys Asp Arg Ala Thr Phe Ser Leu Val Asp Asn Gly Thr Gly Leu Thr
 65 70 75 80
 Ala Gln Glu Ala Arg Glu Leu Leu Ala Thr Val Gly Arg Thr Ser Lys
 85 90 95
 Arg Asp Glu Phe Gly Leu Gln Arg Glu Gly Arg Leu Gly Gln Phe Gly
 100 105 110
 Ile Gly Leu Leu Ser Cys Phe Met Val Ala Asp Glu Ile Thr Met Val
 115 120 125
 Ser His Ala Glu Gly Ala Ser Ala Ile Arg Trp Thr Gly His Ala Asp
 130 135 140
 Gly Thr Phe Asn Leu Glu Ile Leu Gly Asp Asp Ala Thr Asp Val Ile
 145 150 155 160
 Pro Val Gly Thr Thr Val His Leu Thr Pro Arg Pro Asp Glu Arg Thr
 165 170 175
 Leu Leu Thr Glu Asn Ser Val Val Thr Ile Ala Ser Asn Tyr Gly Arg
 180 185 190
 Tyr Leu Pro Ile Pro Ile Val Val Gln Gly Glu Lys Asn Thr Thr Ile
 195 200 205
 Thr Thr Ser Pro Val Phe Ala Lys Asp Thr Asp Gln Gln His Arg Leu
 210 215 220
 Tyr Ala Gly Arg Glu Arg Leu Gly Lys Thr Pro Phe Asp Val Ile Asp
 225 230 235 240
 Leu Thr Gly Pro Gly Ile Glu Gly Val Ala Tyr Val Leu Pro Glu Ala
 245 250 255
 Gln Ala Pro His Met Ser Arg Arg His Ser Ile Tyr Val Asn Arg Met
 260 265 270
 Leu Val Ser Asp Gly Pro Ser Thr Val Leu Pro Asn Trp Ala Phe Phe
 275 280 285
 Val Glu Cys Glu Ile Asn Ser Thr Asp Leu Glu Pro Thr Ala Ser Arg
 290 295 300
 Glu Ala Leu Met Asp Asp Thr Ala Phe Ala Ala Thr Arg Glu His Ile
 305 310 315 320
 Gly Glu Cys Ile Lys Ser Trp Leu Ile Asn Leu Ala Met Thr Lys Pro
 325 330 335

His Arg Val Arg Glu Phe Thr Ala Ile His Asp Leu Ala Leu Arg Glu
 340 345 350
 Leu Cys Gln Ser Asp Ala Asp Leu Ala Glu Thr Met Leu Gly Leu Leu
 355 360 365
 Thr Leu Glu Thr Ser Arg Gly Arg Ile Ser Ile Gly Glu Ile Thr Thr
 370 375 380
 Leu Ser Ile Thr Glu Asp Val Ser Leu Gln Leu Ala Thr Thr Leu Asp
 385 390 395 400
 Asp Phe Arg Gln Leu Asn Thr Ile Ala Arg Pro Asp Thr Leu Ile Ile
 405 410 415
 Asn Gly Gly Tyr Ile His Asp Ser Asp Leu Ala Arg Leu Ile Pro Val
 420 425 430
 His Tyr Pro Pro Leu Thr Val Ser Thr Ala Asp Leu Arg Glu Ser Met
 435 440 445
 Asp Leu Met Glu Leu Pro Pro Leu Gln Asp Ile Glu Lys Ala Lys Ala
 450 455 460
 Leu Asp Ala Gln Val Thr Glu Ser Leu Lys Asp Phe Gln Ile Lys Gly
 465 470 475 480
 Ala Thr Arg Val Phe Glu Pro Ala Asp Val Pro Ala Val Val Ile Ile
 485 490 495
 Asp Ser Lys Ala Gln Ala Ser Arg Asp Arg Asn Glu Thr Gln Ser Ala
 500 505 510
 Thr Thr Asp Arg Trp Ala Asp Ile Leu Ala Thr Val Asp Asn Thr Leu
 515 520 525
 Ser Arg Gln Thr Ala Asn Ile Pro Gln Asp Gln Gly Leu Ser Ala Leu
 530 535 540
 Cys Leu Asn Trp Asn Asn Ser Leu Val Arg Lys Leu Ala Ser Thr Asp
 545 550 555 560
 Asp Thr Ala Val Val Ser Arg Thr Val Arg Leu Leu Tyr Val Gln Ala
 565 570 575
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 Asn Asp Ser Leu Ala Asp Leu Val Ser Leu Ser Leu Ser Ser Asp Ile
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<400> 37

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ctgatgccct gtggattcaa aactgtgctt ttataggcgt atg caa gaa tcc tca    115
                               Met Gln Glu Ser Ser
                               1          5

cgt gat aat ttc caa gtt gac ctc ggc ggc gtt gtt gat ctt ttg agt    163
Arg Asp Asn Phe Gln Val Asp Leu Gly Gly Val Val Asp Leu Leu Ser
          10          15          20

cgc cac att tat tcc ggt ccg agg gtg tat gtg cgt gag ttg ctg cag    211
Arg His Ile Tyr Ser Gly Pro Arg Val Tyr Val Arg Glu Leu Leu Gln
          25          30          35

aat gcg gtt gat gct tgt act gca cgt tct gaa cag ggt gag gag ggc    259
Asn Ala Val Asp Ala Cys Thr Ala Arg Ser Glu Gln Gly Glu Glu Gly
          40          45          50

tac gag ccg agt att cgt att cgg ccg gtg acc aag gat cgt gcc acg    307
Tyr Glu Pro Ser Ile Arg Ile Arg Pro Val Thr Lys Asp Arg Ala Thr
          55          60          65

ttt tca ctg gtt gat aat ggt acg ggc ctg acc gcg cag gag gcg cgg    355
Phe Ser Leu Val Asp Asn Gly Thr Gly Leu Thr Ala Gln Glu Ala Arg
          70          75          80          85

gaa ttg ctg gcg acg gtg ggg cgg acg tcg aaa cgc gat gaa ttc ggt    403
Glu Leu Leu Ala Thr Val Gly Arg Thr Ser Lys Arg Asp Glu Phe Gly
          90          95          100

ctg cag cgg gaa ggt cgc ctg ggg caa ttt ggc    436
Leu Gln Arg Glu Gly Arg Leu Gly Gln Phe Gly
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<210> 38
 <211> 112
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 38

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Met Gln Glu Ser Ser Arg Asp Asn Phe Gln Val Asp Leu Gly Gly Val
  1          5          10          15

Val Asp Leu Leu Ser Arg His Ile Tyr Ser Gly Pro Arg Val Tyr Val
  20          25          30

```

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|-----|-----|-----|-----|---|-----|----|----|---|---|---|---|---|----|-----|
| <400> 39 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| taag | tat | gtt | gg | tc | gt | gt | gc | tc | gt | gg | cg | ga | at | ag | ct | gc | gg | gt | at | ag | tt | gg | cc | att | t | gtt | tt | 60 | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| tg | atta | aat | ct | gt | tt | aga | aag | c | taa | agg | aag | t | at | c | a | c | c | c | a | c | c | c | gt | g | c | a | c | g | t | g | a | c | t | at | 115 |
| | | | | | | | | | | | Val | Ala | Arg | Asp | Tyr | | | | | | | | | | | 5 | | | | | | | | | |
| | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| tac | ggc | att | ctc | ggc | gtc | gat | cgc | aat | gca | acc | gaa | tca | gag | atc | aaa | 163 | | | | | | | | | | | | | | | | | | | |
| Tyr | Gly | Ile | Leu | Gly | Val | Asp | Arg | Asn | Ala | Thr | Glu | Ser | Glu | Ile | Lys | | | | | | | | | | | | | | | | | | | | |
| | | | | 10 | | | | 15 | | | | 20 | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| aag | gca | tac | cga | aag | ctt | gcc | cgc | aaa | tac | cac | ccg | gac | gta | aac | cca | 211 | | | | | | | | | | | | | | | | | | | |
| Lys | Ala | Tyr | Arg | Lys | Leu | Ala | Arg | Lys | Tyr | His | Pro | Asp | Val | Asn | Pro | | | | | | | | | | | | | | | | | | | | |
| | | | | 25 | | | | 30 | | | | 35 | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| gg | t | gag | gaa | gca | g | cg | gag | aaa | t | tc | cgc | gag | g | ct | t | ct | g | tt | g | cg | cat | gag | 259 | | | | | | | | | | | | |
| Gly | Glu | Glu | Ala | Ala | Glu | Lys | Phe | Arg | Glu | Ala | Ser | Val | Ala | His | Glu | | | | | | | | | | | | | | | | | | | | |
| | | | | 40 | | | | 45 | | | | 50 | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| gt | a | ctc | act | gat | ccg | gat | aag | cgc | cgc | att | gtt | gat | atg | ggc | gg | t | gac | 307 | | | | | | | | | | | | | | | | | |
| Val | Leu | Thr | Asp | Pro | Asp | Lys | Arg | Arg | Ile | Val | Asp | Met | Gly | Gly | Asp | | | | | | | | | | | | | | | | | | | | |
| | | | | 55 | | | | 60 | | | | 65 | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| cca | atg | gag | caa | ggc | ggc | gga | gct | ggc | gct | gg | t | ggc | t | tc | gg | t | gga | ggc | 355 | | | | | | | | | | | | | | | | |
| Pro | Met | Glu | Gln | Gly | Gly | Gly | Ala | Gly | Ala | Gly | Gly | Phe | Gly | Gly | Gly | | | | | | | | | | | | | | | | | | | | |
| | | | | 70 | | | | 75 | | | | 80 | | | | 85 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ttc | ggc | ggc | agc | gg | t | gga | ctg | ggc | gat | atc | ttc | gat | gcc | ttc | ttc | ggc | 403 | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| Phe | Gly | Gly | Ser | Gly | Gly | Leu | Gly | Asp | Ile | Phe | Asp | Ala | Phe | Phe | Gly | | |
| | | | | 90 | | | | | 95 | | | | | | 100 | | |
| ggt | ggc | gcg | ggc | ggt | tcc | cgt | gga | cca | cgt | tcc | cgc | gtg | cag | cca | ggc | 451 | |
| Gly | Gly | Ala | Gly | Gly | Ser | Arg | Gly | Pro | Arg | Ser | Arg | Val | Gln | Pro | Gly | | |
| | | | 105 | | | | | 110 | | | | | 115 | | | | |
| agt | gac | acc | ttg | tgg | cgc | acc | tcc | atc | acc | ttg | gaa | gag | gct | tac | aag | 499 | |
| Ser | Asp | Thr | Leu | Trp | Arg | Thr | Ser | Ile | Thr | Leu | Glu | Glu | Ala | Tyr | Lys | | |
| | | 120 | | | | | 125 | | | | | 130 | | | | | |
| ggc | gct | aag | aaa | gat | ctc | acc | ctt | gac | acc | gca | gtg | ctg | tgt | acc | aag | 547 | |
| Gly | Ala | Lys | Lys | Asp | Leu | Thr | Leu | Asp | Thr | Ala | Val | Leu | Cys | Thr | Lys | | |
| | 135 | | | | | 140 | | | | | 145 | | | | | | |
| tgt | cat | ggt | tct | gga | tct | gca | tcc | gac | aag | aag | cct | gtt | acc | tgt | ggc | 595 | |
| Cys | His | Gly | Ser | Gly | Ser | Ala | Ser | Asp | Lys | Lys | Pro | Val | Thr | Cys | Gly | | |
| 150 | | | | | 155 | | | | 160 | | | | | | 165 | | |
| acc | tgt | aat | ggc | gct | ggt | gaa | att | cag | gaa | gtg | cag | cgc | agc | ttc | ctg | 643 | |
| Thr | Cys | Asn | Gly | Ala | Gly | Glu | Ile | Gln | Glu | Val | Gln | Arg | Ser | Phe | Leu | | |
| | | | | 170 | | | | 175 | | | | | | 180 | | | |
| ggc | aac | gtc | atg | acg | tcc | cgc | cca | tgc | cac | acc | tgc | gat | ggc | acc | ggt | 691 | |
| Gly | Asn | Val | Met | Thr | Ser | Arg | Pro | Cys | His | Thr | Cys | Asp | Gly | Thr | Gly | | |
| | | 185 | | | | | | 190 | | | | | 195 | | | | |
| gag | atc | atc | cca | gat | cct | tgc | act | gag | tgt | gca | gca | gat | ggt | cgt | gtg | 739 | |
| Glu | Ile | Ile | Pro | Asp | Pro | Cys | Thr | Glu | Cys | Ala | Ala | Asp | Gly | Arg | Val | | |
| | | 200 | | | | 205 | | | | | | 210 | | | | | |
| cgt | gct | cgc | cgc | gac | atc | gtg | gcc | aac | atc | cca | gct | ggc | atc | cag | tcc | 787 | |
| Arg | Ala | Arg | Arg | Asp | Ile | Val | Ala | Asn | Ile | Pro | Ala | Gly | Ile | Gln | Ser | | |
| | 215 | | | | | 220 | | | | 225 | | | | | | | |
| ggc | atg | cgc | atc | cgc | atg | gca | ggc | caa | ggt | gag | gtt | ggc | gct | ggt | ggc | 835 | |
| Gly | Met | Arg | Ile | Arg | Met | Ala | Gly | Gln | Gly | Glu | Val | Gly | Ala | Gly | Gly | | |
| 230 | | | | | 235 | | | | 240 | | | | | | 245 | | |
| ggt | cct | gcg | ggt | gac | ctc | tac | att | gaa | gtc | atg | gtg | cgc | ccg | cac | gcc | 883 | |
| Gly | Pro | Ala | Gly | Asp | Leu | Tyr | Ile | Glu | Val | Met | Val | Arg | Pro | His | Ala | | |
| | | | 250 | | | | | 255 | | | | | 260 | | | | |
| atc | ttc | acc | cgc | gat | ggc | gac | gat | ctg | cac | gcc | agc | atc | aag | gtt | cca | 931 | |
| Ile | Phe | Thr | Arg | Asp | Gly | Asp | Asp | Leu | His | Ala | Ser | Ile | Lys | Val | Pro | | |
| | | 265 | | | | | 270 | | | | | | 275 | | | | |
| atg | ttc | gat | gca | gcg | ctt | ggc | acc | gaa | ttg | gac | gtg | gaa | tcc | ctc | acc | 979 | |
| Met | Phe | Asp | Ala | Ala | Leu | Gly | Thr | Glu | Leu | Asp | Val | Glu | Ser | Leu | Thr | | |
| | | 280 | | | | 285 | | | | | | 290 | | | | | |
| ggc | gaa | gag | gtg | aaa | att | acc | atc | cct | gca | ggt | act | cag | ccc | aac | gat | 1027 | |
| Gly | Glu | Glu | Val | Lys | Ile | Thr | Ile | Pro | Ala | Gly | Thr | Gln | Pro | Asn | Asp | | |
| | 295 | | | | | 300 | | | | 305 | | | | | | | |
| gtg | atc | acc | ttg | gat | ggt | gaa | ggc | atg | ccg | aag | ctg | cgc | gca | gaa | ggc | 1075 | |
| Val | Ile | Thr | Leu | Asp | Gly | Glu | Gly | Met | Pro | Lys | Leu | Arg | Ala | Glu | Gly | | |

| 310 | 315 | 320 | 325 | |
|---|-----|-----|-----|------|
| cac ggc aac ctc atg gcg cat gtc gat cta ttt gtg cca acc gat ttg | | | | 1123 |
| His Gly Asn Leu Met Ala His Val Asp Leu Phe Val Pro Thr Asp Leu | | | | |
| | 330 | 335 | 340 | |
| gat gac cgc acc cgc gaa ttg ctt gaa gaa atc cgc aac cat cgc agc | | | | 1171 |
| Asp Asp Arg Thr Arg Glu Leu Leu Glu Glu Ile Arg Asn His Arg Ser | | | | |
| | 345 | 350 | 355 | |
| gac aac gct tcc gtg cat cgc gaa ggc gga gaa gaa tcc ggt ttc ttt | | | | 1219 |
| Asp Asn Ala Ser Val His Arg Glu Gly Gly Glu Glu Ser Gly Phe Phe | | | | |
| | 360 | 365 | 370 | |
| gac aag ctc cga aac aag ttc cgc aaa taatgtcact gccagtatatt | | | | 1266 |
| Asp Lys Leu Arg Asn Lys Phe Arg Lys | | | | |
| | 375 | 380 | | |
| atc | | | | 1269 |
| | | | | |
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| <211> 382 | | | | |
| <212> PRT | | | | |
| <213> Corynebacterium glutamicum | | | | |
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| <400> 40 | | | | |
| Val Ala Arg Asp Tyr Tyr Gly Ile Leu Gly Val Asp Arg Asn Ala Thr | | | | |
| 1 | 5 | 10 | 15 | |
| Glu Ser Glu Ile Lys Lys Ala Tyr Arg Lys Leu Ala Arg Lys Tyr His | | | | |
| | 20 | 25 | 30 | |
| Pro Asp Val Asn Pro Gly Glu Glu Ala Ala Glu Lys Phe Arg Glu Ala | | | | |
| | 35 | 40 | 45 | |
| Ser Val Ala His Glu Val Leu Thr Asp Pro Asp Lys Arg Arg Ile Val | | | | |
| | 50 | 55 | 60 | |
| Asp Met Gly Gly Asp Pro Met Glu Gln Gly Gly Gly Ala Gly Ala Gly | | | | |
| | 65 | 70 | 75 | 80 |
| Gly Phe Gly Gly Gly Phe Gly Gly Ser Gly Gly Leu Gly Asp Ile Phe | | | | |
| | 85 | 90 | 95 | |
| Asp Ala Phe Phe Gly Gly Gly Ala Gly Gly Ser Arg Gly Pro Arg Ser | | | | |
| | 100 | 105 | 110 | |
| Arg Val Gln Pro Gly Ser Asp Thr Leu Trp Arg Thr Ser Ile Thr Leu | | | | |
| | 115 | 120 | 125 | |
| Glu Glu Ala Tyr Lys Gly Ala Lys Lys Asp Leu Thr Leu Asp Thr Ala | | | | |
| | 130 | 135 | 140 | |
| Val Leu Cys Thr Lys Cys His Gly Ser Gly Ser Ala Ser Asp Lys Lys | | | | |
| | 145 | 150 | 155 | 160 |

Pro Val Thr Cys Gly Thr Cys Asn Gly Ala Gly Glu Ile Gln Glu Val
 165 170 175
 Gln Arg Ser Phe Leu Gly Asn Val Met Thr Ser Arg Pro Cys His Thr
 180 185 190
 Cys Asp Gly Thr Gly Glu Ile Ile Pro Asp Pro Cys Thr Glu Cys Ala
 195 200 205
 Ala Asp Gly Arg Val Arg Ala Arg Arg Asp Ile Val Ala Asn Ile Pro
 210 215 220
 Ala Gly Ile Gln Ser Gly Met Arg Ile Arg Met Ala Gly Gln Gly Glu
 225 230 235 240
 Val Gly Ala Gly Gly Gly Pro Ala Gly Asp Leu Tyr Ile Glu Val Met
 245 250 255
 Val Arg Pro His Ala Ile Phe Thr Arg Asp Gly Asp Asp Leu His Ala
 260 265 270
 Ser Ile Lys Val Pro Met Phe Asp Ala Ala Leu Gly Thr Glu Leu Asp
 275 280 285
 Val Glu Ser Leu Thr Gly Glu Glu Val Lys Ile Thr Ile Pro Ala Gly
 290 295 300
 Thr Gln Pro Asn Asp Val Ile Thr Leu Asp Gly Glu Gly Met Pro Lys
 305 310 315 320
 Leu Arg Ala Glu Gly His Gly Asn Leu Met Ala His Val Asp Leu Phe
 325 330 335
 Val Pro Thr Asp Leu Asp Asp Arg Thr Arg Glu Leu Leu Glu Glu Ile
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 Arg Asn His Arg Ser Asp Asn Ala Ser Val His Arg Glu Gly Gly Glu
 355 360 365
 Glu Ser Gly Phe Phe Asp Lys Leu Arg Asn Lys Phe Arg Lys
 370 375 380

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 <223> RXS00568

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| | | | | | | | | | | | | | | | Val | Lys | Ser | Ser | Val | |
|---|-----|--|--|-----|--|--|--|-----|--|--|--|--|--|-----|-----|-----|-----|-----|-----|--|
| | | | | | | | | | | | | | | | 1 | | | | 5 | |
| gag aag ctg agc gac acc cgt tca aag atc acc gtt gag gtt cca ttt | 163 | | | | | | | | | | | | | | | | | | | |
| Glu Lys Leu Ser Asp Thr Arg Ser Lys Ile Thr Val Glu Val Pro Phe | | | | | | | | | | | | | | | | | | | | |
| | | | | 10 | | | | 15 | | | | | | 20 | | | | | | |
| tct gaa ctg aag cca gag atc gac cag gca tac gcc gct cta gcg cag | 211 | | | | | | | | | | | | | | | | | | | |
| Ser Glu Leu Lys Pro Glu Ile Asp Gln Ala Tyr Ala Ala Leu Ala Gln | | | | | | | | | | | | | | | | | | | | |
| | | | | 25 | | | | 30 | | | | | | 35 | | | | | | |
| caa gtc cag atc cct ggt ttc cgt aag ggc aag gca ccg cgt cag ctt | 259 | | | | | | | | | | | | | | | | | | | |
| Gln Val Gln Ile Pro Gly Phe Arg Lys Gly Lys Ala Pro Arg Gln Leu | | | | | | | | | | | | | | | | | | | | |
| | | | | 40 | | | | 45 | | | | | | 50 | | | | | | |
| atc gac gca cgc ttc ggc cgt ggt gcg gtt ctg gag cag gtt gtc aac | 307 | | | | | | | | | | | | | | | | | | | |
| Ile Asp Ala Arg Phe Gly Arg Gly Ala Val Leu Glu Gln Val Val Asn | | | | | | | | | | | | | | | | | | | | |
| | | | | 55 | | | | 60 | | | | | | 65 | | | | | | |
| gac atg ctt cct aac cgc tac gca cag gca atc gaa gct gag ggc atc | 355 | | | | | | | | | | | | | | | | | | | |
| Asp Met Leu Pro Asn Arg Tyr Ala Gln Ala Ile Glu Ala Glu Gly Ile | | | | | | | | | | | | | | | | | | | | |
| | | | | 70 | | | | 75 | | | | | | 80 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| aag gca atc ggc cag cct aac gta gag gtc acc aag atc gaa gac aac | 403 | | | | | | | | | | | | | | | | | | | |
| Lys Ala Ile Gly Gln Pro Asn Val Glu Val Thr Lys Ile Glu Asp Asn | | | | | | | | | | | | | | | | | | | | |
| | | | | 90 | | | | 95 | | | | | | 100 | | | | | | |
| gag ctc gtt gag ttc gtc gct gag gtt gac gtt cgc cca gag ttc gag | 451 | | | | | | | | | | | | | | | | | | | |
| Glu Leu Val Glu Phe Val Ala Glu Val Asp Val Arg Pro Glu Phe Glu | | | | | | | | | | | | | | | | | | | | |
| | | | | 105 | | | | 110 | | | | | | 115 | | | | | | |
| ctt cct aag ttc gag gac atc act gtt gag gtc cca gct atc aag gct | 499 | | | | | | | | | | | | | | | | | | | |
| Leu Pro Lys Phe Glu Asp Ile Thr Val Glu Val Pro Ala Ile Lys Ala | | | | | | | | | | | | | | | | | | | | |
| | | | | 120 | | | | 125 | | | | | | 130 | | | | | | |
| gac gaa gag gca atc gaa gca gag ctc gag acc ctg cgt gca cgt ttc | 547 | | | | | | | | | | | | | | | | | | | |
| Asp Glu Glu Ala Ile Glu Ala Glu Leu Glu Thr Leu Arg Ala Arg Phe | | | | | | | | | | | | | | | | | | | | |
| | | | | 135 | | | | 140 | | | | | | 145 | | | | | | |
| tcc acc ttg aag gat cac aac cac aag ctg aag aag ggt gag ttc gtc | 595 | | | | | | | | | | | | | | | | | | | |
| Ser Thr Leu Lys Asp His Asn His Lys Leu Lys Lys Gly Glu Phe Val | | | | | | | | | | | | | | | | | | | | |
| | | | | 150 | | | | 155 | | | | | | 160 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| acc atc aac atc acc gca agc att gac ggt gag aag att gaa gag gca | 643 | | | | | | | | | | | | | | | | | | | |
| Thr Ile Asn Ile Thr Ala Ser Ile Asp Gly Glu Lys Ile Glu Glu Ala | | | | | | | | | | | | | | | | | | | | |
| | | | | 170 | | | | 175 | | | | | | 180 | | | | | | |
| acc act gag ggt ctg tcc tac gaa atc gga tct gac gat ctg att gac | 691 | | | | | | | | | | | | | | | | | | | |
| Thr Thr Glu Gly Leu Ser Tyr Glu Ile Gly Ser Asp Asp Leu Ile Asp | | | | | | | | | | | | | | | | | | | | |
| | | | | 185 | | | | 190 | | | | | | 195 | | | | | | |
| ggc ctg gac aag gct ctg atc ggc gct aag aag gat gaa acc gta gag | 739 | | | | | | | | | | | | | | | | | | | |
| Gly Leu Asp Lys Ala Leu Ile Gly Ala Lys Lys Asp Glu Thr Val Glu | | | | | | | | | | | | | | | | | | | | |
| | | | | 200 | | | | 205 | | | | | | 210 | | | | | | |
| ttc acc tct gag ctg gca aac ggc gag cac aag ggc aag gaa gct caa | 787 | | | | | | | | | | | | | | | | | | | |
| Phe Thr Ser Glu Leu Ala Asn Gly Glu His Lys Gly Lys Glu Ala Gln | | | | | | | | | | | | | | | | | | | | |

| 215 | 220 | 225 | |
|---|-----|-----|------|
| atc agc gtt gag atc acc gca acc aag cag cgc gag ctg cct gag ctg | | | 835 |
| Ile Ser Val Glu Ile Thr Ala Thr Lys Gln Arg Glu Leu Pro Glu Leu | | | |
| 230 | 235 | 240 | 245 |
| gat gat gag ttc gca cag ctg gct tct gag ttc gac acc atc gaa gag | | | 883 |
| Asp Asp Glu Phe Ala Gln Leu Ala Ser Glu Phe Asp Thr Ile Glu Glu | | | |
| | 250 | 255 | 260 |
| ctt cgt gag tcc acc gtg tct gac gtt gag gct aag cag aag aac gag | | | 931 |
| Leu Arg Glu Ser Thr Val Ser Asp Val Glu Ala Lys Gln Lys Asn Glu | | | |
| | 265 | 270 | 275 |
| cag gct gct gca atc cgc gac gaa gtt ctc gct gcg gct ctt ggc gag | | | 979 |
| Gln Ala Ala Ala Ile Arg Asp Glu Val Leu Ala Ala Ala Leu Gly Glu | | | |
| | 280 | 285 | 290 |
| gct gac ttc gct ctg cca cag tcc atc gtt gac gag cag gca cac tcc | | | 1027 |
| Ala Asp Phe Ala Leu Pro Gln Ser Ile Val Asp Glu Gln Ala His Ser | | | |
| | 295 | 300 | 305 |
| cag ctg cac cag ctc ctc ggc gag ctt gca cac gac gat gct gca ctg | | | 1075 |
| Gln Leu His Gln Leu Leu Gly Glu Leu Ala His Asp Asp Ala Ala Leu | | | |
| 310 | 315 | 320 | 325 |
| aac tcc ctc ctt gag gct cag ggc acc act cgt gaa gag ttc gac aag | | | 1123 |
| Asn Ser Leu Leu Glu Ala Gln Gly Thr Thr Arg Glu Glu Phe Asp Lys | | | |
| | 330 | 335 | 340 |
| aag aac gtc gaa gat gct gag aag gct gtt cgc acc cag ctg ttc ctg | | | 1171 |
| Lys Asn Val Glu Asp Ala Glu Lys Ala Val Arg Thr Gln Leu Phe Leu | | | |
| | 345 | 350 | 355 |
| gac acc ctc tct gag gtt gag gag cct gag gtt tcc cag cag gag ctc | | | 1219 |
| Asp Thr Leu Ser Glu Val Glu Glu Pro Glu Val Ser Gln Gln Glu Leu | | | |
| | 360 | 365 | 370 |
| acc gac cac atc ctg ttc acc gca cag tct tac ggc atg gac cca aac | | | 1267 |
| Thr Asp His Ile Leu Phe Thr Ala Gln Ser Tyr Gly Met Asp Pro Asn | | | |
| | 375 | 380 | 385 |
| cag ttc atc ggt cag ctg cag cag tcc ggc cag atc gcg aac ctc ttc | | | 1315 |
| Gln Phe Ile Gly Gln Leu Gln Gln Ser Gly Gln Ile Ala Asn Leu Phe | | | |
| 390 | 395 | 400 | 405 |
| tcc gac gtt cgc cgt ggc aag gct ctt gca cag gct atc tgc cgc gta | | | 1363 |
| Ser Asp Val Arg Arg Gly Lys Ala Leu Ala Gln Ala Ile Cys Arg Val | | | |
| | 410 | 415 | 420 |
| aac gtg aag gac tcc gag ggt aac gag atc gac cct aag gaa tac ttc | | | 1411 |
| Asn Val Lys Asp Ser Glu Gly Asn Glu Ile Asp Pro Lys Glu Tyr Phe | | | |
| | 425 | 430 | 435 |
| ggt gaa gaa gaa gta gct gag act gag tct gaa gct taaaaacttt | | | 1457 |
| Gly Glu Glu Glu Val Ala Glu Thr Glu Ser Glu Ala | | | |
| 440 | 445 | | |

aaagaaataa cgc

1470

<210> 42

<211> 449

<212> PRT

<213> Corynebacterium glutamicum

<400> 42

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Lys | Ser | Ser | Val | Glu | Lys | Leu | Ser | Asp | Thr | Arg | Ser | Lys | Ile | Thr |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Glu | Val | Pro | Phe | Ser | Glu | Leu | Lys | Pro | Glu | Ile | Asp | Gln | Ala | Tyr |
| | | | 20 | | | | | 25 | | | | | 30 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Ala | Leu | Ala | Gln | Gln | Val | Gln | Ile | Pro | Gly | Phe | Arg | Lys | Gly | Lys |
| | | 35 | | | | | 40 | | | | | 45 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Pro | Arg | Gln | Leu | Ile | Asp | Ala | Arg | Phe | Gly | Arg | Gly | Ala | Val | Leu |
| | 50 | | | | | 55 | | | | | 60 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Gln | Val | Val | Asn | Asp | Met | Leu | Pro | Asn | Arg | Tyr | Ala | Gln | Ala | Ile |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Ala | Glu | Gly | Ile | Lys | Ala | Ile | Gly | Gln | Pro | Asn | Val | Glu | Val | Thr |
| | | | | 85 | | | | | 90 | | | | | 95 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Lys | Ile | Glu | Asp | Asn | Glu | Leu | Val | Glu | Phe | Val | Ala | Glu | Val | Asp | Val |
| | | | 100 | | | | | 105 | | | | | | 110 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Arg | Pro | Glu | Phe | Glu | Leu | Pro | Lys | Phe | Glu | Asp | Ile | Thr | Val | Glu | Val |
| | | 115 | | | | | 120 | | | | | 125 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Pro | Ala | Ile | Lys | Ala | Asp | Glu | Glu | Ala | Ile | Glu | Ala | Glu | Leu | Glu | Thr |
| | 130 | | | | | 135 | | | | | 140 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Arg | Ala | Arg | Phe | Ser | Thr | Leu | Lys | Asp | His | Asn | His | Lys | Leu | Lys |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Lys | Gly | Glu | Phe | Val | Thr | Ile | Asn | Ile | Thr | Ala | Ser | Ile | Asp | Gly | Glu |
| | | | 165 | | | | | | 170 | | | | | 175 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Lys | Ile | Glu | Glu | Ala | Thr | Thr | Glu | Gly | Leu | Ser | Tyr | Glu | Ile | Gly | Ser |
| | | | 180 | | | | | 185 | | | | | | 190 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asp | Asp | Leu | Ile | Asp | Gly | Leu | Asp | Lys | Ala | Leu | Ile | Gly | Ala | Lys | Lys |
| | | 195 | | | | | 200 | | | | | 205 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asp | Glu | Thr | Val | Glu | Phe | Thr | Ser | Glu | Leu | Ala | Asn | Gly | Glu | His | Lys |
| | 210 | | | | | 215 | | | | | 220 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Gly | Lys | Glu | Ala | Gln | Ile | Ser | Val | Glu | Ile | Thr | Ala | Thr | Lys | Gln | Arg |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Leu | Pro | Glu | Leu | Asp | Asp | Glu | Phe | Ala | Gln | Leu | Ala | Ser | Glu | Phe |
| | | | | 245 | | | | | 250 | | | | | 255 | |

Asp Thr Ile Glu Glu Leu Arg Glu Ser Thr Val Ser Asp Val Glu Ala
 260 265 270
 Lys Gln Lys Asn Glu Gln Ala Ala Ala Ile Arg Asp Glu Val Leu Ala
 275 280 285
 Ala Ala Leu Gly Glu Ala Asp Phe Ala Leu Pro Gln Ser Ile Val Asp
 290 295 300
 Glu Gln Ala His Ser Gln Leu His Gln Leu Leu Gly Glu Leu Ala His
 305 310 315 320
 Asp Asp Ala Ala Leu Asn Ser Leu Leu Glu Ala Gln Gly Thr Thr Arg
 325 330 335
 Glu Glu Phe Asp Lys Lys Asn Val Glu Asp Ala Glu Lys Ala Val Arg
 340 345 350
 Thr Gln Leu Phe Leu Asp Thr Leu Ser Glu Val Glu Glu Pro Glu Val
 355 360 365
 Ser Gln Gln Glu Leu Thr Asp His Ile Leu Phe Thr Ala Gln Ser Tyr
 370 375 380
 Gly Met Asp Pro Asn Gln Phe Ile Gly Gln Leu Gln Gln Ser Gly Gln
 385 390 395 400
 Ile Ala Asn Leu Phe Ser Asp Val Arg Arg Gly Lys Ala Leu Ala Gln
 405 410 415
 Ala Ile Cys Arg Val Asn Val Lys Asp Ser Glu Gly Asn Glu Ile Asp
 420 425 430
 Pro Lys Glu Tyr Phe Gly Glu Glu Glu Val Ala Glu Thr Glu Ser Glu
 435 440 445

Ala

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 <223> RXN03038

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 ccaaacacgt tcaaattccgt taaagtgcct gtttaaaact atg cat tca aag gaa 115
 Met His Ser Lys Glu
 1 5

| | |
|---|-----|
| gag tta aca gtg cgt aaa gga att tcc cgc gtc ctc tcg gta gcg gtt | 163 |
| Glu Leu Thr Val Arg Lys Gly Ile Ser Arg Val Leu Ser Val Ala Val | |
| 10 15 20 | |
| gct agt tca atc gga ttc gga act gta ctg aca ggc acc ggc atc gca | 211 |
| Ala Ser Ser Ile Gly Phe Gly Thr Val Leu Thr Gly Thr Gly Ile Ala | |
| 25 30 35 | |
| gca gct caa gac tct gca ttt gac tac ggt atg gat cca aac atg aac | 259 |
| Ala Ala Gln Asp Ser Ala Phe Asp Tyr Gly Met Asp Pro Asn Met Asn | |
| 40 45 50 | |
| tac aac ccg atc gat gac atc aag gat cgt ccc gaa gga ttg tcc aat | 307 |
| Tyr Asn Pro Ile Asp Asp Ile Lys Asp Arg Pro Glu Gly Leu Ser Asn | |
| 55 60 65 | |
| ctt ccc tac ttc gga agt aaa ttg acc agc tgg ggc tca tca tat gcc | 355 |
| Leu Pro Tyr Phe Gly Ser Lys Leu Thr Ser Trp Gly Ser Ser Tyr Ala | |
| 70 75 80 85 | |
| acc gcc tca tcc ggc gtc gtg acc tcc gcg ctc ccg cag tac acc gat | 403 |
| Thr Ala Ser Ser Gly Val Val Thr Ser Ala Leu Pro Gln Tyr Thr Asp | |
| 90 95 100 | |
| ccg cgc tac ccc ctc ggc aaa gac gac ctg ccc aag gca acc atc gac | 451 |
| Pro Arg Tyr Pro Leu Gly Lys Asp Asp Leu Pro Lys Ala Thr Ile Asp | |
| 105 110 115 | |
| atg gag cca gaa gtt ctt gcg cgc ctt gag cga ttc gtc ggc gtt gac | 499 |
| Met Glu Pro Glu Val Leu Ala Arg Leu Glu Arg Phe Val Gly Val Asp | |
| 120 125 130 | |
| ggt gat cgc atc cgc caa atc aac gcg tac tcg cca tca atg gga cgc | 547 |
| Gly Asp Arg Ile Arg Gln Ile Asn Ala Tyr Ser Pro Ser Met Gly Arg | |
| 135 140 145 | |
| acc att cct cta gtc tgg gtt gtt cca gaa gac aac acc gtg cct ggc | 595 |
| Thr Ile Pro Leu Val Trp Val Val Pro Glu Asp Asn Thr Val Pro Gly | |
| 150 155 160 165 | |
| cca acg gtc tac gca ctc gga ggc ggt gac ggt gga caa ggc ggc cag | 643 |
| Pro Thr Val Tyr Ala Leu Gly Gly Gly Asp Gly Gly Gln Gly Gly Gln | |
| 170 175 180 | |
| aac tgg gtc acc cgc acc gac ctt gag gaa tta acc agt gac aac aac | 691 |
| Asn Trp Val Thr Arg Thr Asp Leu Glu Glu Leu Thr Ser Asp Asn Asn | |
| 185 190 195 | |
| atc aac ctc atc atg ccg atg ctc gga tct ttt agt ttc tac tct gac | 739 |
| Ile Asn Leu Ile Met Pro Met Leu Gly Ser Phe Ser Phe Tyr Ser Asp | |
| 200 205 210 | |
| tgg gca cgc gaa agc caa tcc atg ggt tgt gcg caa cag tgg gaa aca | 787 |
| Trp Ala Arg Glu Ser Gln Ser Met Gly Cys Ala Gln Gln Trp Glu Thr | |
| 215 220 225 | |

ttg ctc atg cac gaa ctg cct gag ccg ctt gta gcg gcc
 Leu Leu Met His Glu Leu Pro Glu Pro Leu Val Ala Ala
 230 235 240

826

<210> 44
 <211> 242
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 44
 Met His Ser Lys Glu Glu Leu Thr Val Arg Lys Gly Ile Ser Arg Val
 1 5 10 15

Leu Ser Val Ala Val Ala Ser Ser Ile Gly Phe Gly Thr Val Leu Thr
 20 25 30

Gly Thr Gly Ile Ala Ala Ala Gln Asp Ser Ala Phe Asp Tyr Gly Met
 35 40 45

Asp Pro Asn Met Asn Tyr Asn Pro Ile Asp Asp Ile Lys Asp Arg Pro
 50 55 60

Glu Gly Leu Ser Asn Leu Pro Tyr Phe Gly Ser Lys Leu Thr Ser Trp
 65 70 75 80

Gly Ser Ser Tyr Ala Thr Ala Ser Ser Gly Val Val Thr Ser Ala Leu
 85 90 95

Pro Gln Tyr Thr Asp Pro Arg Tyr Pro Leu Gly Lys Asp Asp Leu Pro
 100 105 110

Lys Ala Thr Ile Asp Met Glu Pro Glu Val Leu Ala Arg Leu Glu Arg
 115 120 125

Phe Val Gly Val Asp Gly Asp Arg Ile Arg Gln Ile Asn Ala Tyr Ser
 130 135 140

Pro Ser Met Gly Arg Thr Ile Pro Leu Val Trp Val Val Pro Glu Asp
 145 150 155 160

Asn Thr Val Pro Gly Pro Thr Val Tyr Ala Leu Gly Gly Gly Asp Gly
 165 170 175

Gly Gln Gly Gly Gln Asn Trp Val Thr Arg Thr Asp Leu Glu Glu Leu
 180 185 190

Thr Ser Asp Asn Asn Ile Asn Leu Ile Met Pro Met Leu Gly Ser Phe
 195 200 205

Ser Phe Tyr Ser Asp Trp Ala Arg Glu Ser Gln Ser Met Gly Cys Ala
 210 215 220

Gln Gln Trp Glu Thr Leu Leu Met His Glu Leu Pro Glu Pro Leu Val
 225 230 235 240

Ala Ala

<210> 45
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 <213> Corynebacterium glutamicum

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 <223> RXN03039

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 1 5 10 15
 ctg ccc aaa gca acc atc gac atg gag cca gaa gct ctt gcg cgc ctt 96
 Leu Pro Lys Ala Thr Ile Asp Met Glu Pro Glu Ala Leu Ala Arg Leu
 20 25 30
 gag cga ttc gtc ggc gtt gac ggt gat cgc atc cgc caa atc aac gcg 144
 Glu Arg Phe Val Gly Val Asp Gly Asp Arg Ile Arg Gln Ile Asn Ala
 35 40 45
 tac tcg cca tca atg gga cgc acc att cct cta gtc tgg gtc gtg cca 192
 Tyr Ser Pro Ser Met Gly Arg Thr Ile Pro Leu Val Trp Val Val Pro
 50 55 60
 gaa gac aac acc gtg cct ggc cca acg gtc tac gca ctc ggc ggc ggc 240
 Glu Asp Asn Thr Val Pro Gly Pro Thr Val Tyr Ala Leu Gly Gly Gly
 65 70 75 80
 gac ggt ggc caa ggc ggc caa aac tgg gtc acc cgc acc gac ctt gat 288
 Asp Gly Gly Gln Gly Gly Gln Asn Trp Val Thr Arg Thr Asp Leu Asp
 85 90 95
 gag ttg acc agt gaa aac aac atc aac ctc atc atg ccc atg ctc gga 336
 Glu Leu Thr Ser Glu Asn Asn Ile Asn Leu Ile Met Pro Met Leu Gly
 100 105 110
 tct ttt agt ttc tac gct gac tgg gca ggc gaa agc gaa tcc atg ggt 384
 Ser Phe Ser Phe Tyr Ala Asp Trp Ala Gly Glu Ser Glu Ser Met Gly
 115 120 125
 ggt gcg caa cag tgg gaa aca ttc ctc atg cac gaa ctr ccm gag ccg 432
 Gly Ala Gln Gln Trp Glu Thr Phe Leu Met His Glu Xaa Xaa Glu Pro
 130 135 140
 cta gaa gcg gcc atc ggc gca gac ggg caa cgc agc atc gtc ggc atg 480
 Leu Glu Ala Ala Ile Gly Ala Asp Gly Gln Arg Ser Ile Val Gly Met
 145 150 155 160
 tcc atg tcc ggg gga tcr gtg ctg aac ttt gcg acg cat gac ccc aac 528
 Ser Met Ser Gly Gly Xaa Val Leu Asn Phe Ala Thr His Asp Pro Asn
 165 170 175

ttt tay tcc tck gtc ggc tca ttt tct gga tgt gcc gaa acc aac tcc 576
 Phe Xaa Ser Xaa Val Gly Ser Phe Ser Gly Cys Ala Glu Thr Asn Ser
 180 185 190

tgg atg ggr cgc cgn tgg cat cgc agc cac tgc cta caa cgg caa tgt 624
 Trp Met Xaa Arg Arg Trp His Arg Ser His Cys Leu Gln Arg Gln Cys
 195 200 205

cgt gcc tgagcaaatc tttggtgaag tag 653
 Arg Ala
 210

<210> 46

<211> 210

<212> PRT

<213> Corynebacterium glutamicum

<400> 46

Ala Leu Pro Gln Tyr Thr Asp Pro Arg Tyr Pro Leu Gly Lys Asp Asp
 1 5 10 15

Leu Pro Lys Ala Thr Ile Asp Met Glu Pro Glu Ala Leu Ala Arg Leu
 20 25 30

Glu Arg Phe Val Gly Val Asp Gly Asp Arg Ile Arg Gln Ile Asn Ala
 35 40 45

Tyr Ser Pro Ser Met Gly Arg Thr Ile Pro Leu Val Trp Val Val Pro
 50 55 60

Glu Asp Asn Thr Val Pro Gly Pro Thr Val Tyr Ala Leu Gly Gly Gly
 65 70 75 80

Asp Gly Gly Gln Gly Gly Gln Asn Trp Val Thr Arg Thr Asp Leu Asp
 85 90 95

Glu Leu Thr Ser Glu Asn Asn Ile Asn Leu Ile Met Pro Met Leu Gly
 100 105 110

Ser Phe Ser Phe Tyr Ala Asp Trp Ala Gly Glu Ser Glu Ser Met Gly
 115 120 125

Gly Ala Gln Gln Trp Glu Thr Phe Leu Met His Glu Xaa Xaa Glu Pro
 130 135 140

Leu Glu Ala Ala Ile Gly Ala Asp Gly Gln Arg Ser Ile Val Gly Met
 145 150 155 160

Ser Met Ser Gly Gly Xaa Val Leu Asn Phe Ala Thr His Asp Pro Asn
 165 170 175

Phe Xaa Ser Xaa Val Gly Ser Phe Ser Gly Cys Ala Glu Thr Asn Ser
 180 185 190

Trp Met Xaa Arg Arg Trp His Arg Ser His Cys Leu Gln Arg Gln Cys

195

200

205

Arg Ala
210

<210> 47
<211> 432
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<223> RXN03040

<400> 47
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ctctacatct tcgccggttc cggtgtgttc tctgaactag atg tca tnc ggt gac 115
Met Ser Xaa Gly Asp
1 5

aac gca ccg att gat gag gat gcg ttc aaa aac cgc gtc ttg gtt ggg 163
Asn Ala Pro Ile Asp Glu Asp Ala Phe Lys Asn Arg Val Leu Val Gly
10 15 20

ttt gaa atc gaa gct atg tcc aac acc tgc acc cat aac ctc aag gct 211
Phe Glu Ile Glu Ala Met Ser Asn Thr Cys Thr His Asn Leu Lys Ala
25 30 35

gcg acc gat caa atg ggc atc gac aac atc aac tac gat ttc cga cca 259
Ala Thr Asp Gln Met Gly Ile Asp Asn Ile Asn Tyr Asp Phe Arg Pro
40 45 50

acc gga acc cac gcc tgg gat tac tgg aac gaa gcg ctc cac cgc ttc 307
Thr Gly Thr His Ala Trp Asp Tyr Trp Asn Glu Ala Leu His Arg Phe
55 60 65

ttc ccg ttg atg atg cag ggc ttc ggc ctc gac ggt ggt ccc atc ccg 355
Phe Pro Leu Met Met Gln Gly Phe Gly Leu Asp Gly Gly Pro Ile Pro
70 75 80 85

atc tat aac cct aac ggt gtg acc tcc agc gag tct tct ntc aga act 403
Ile Tyr Asn Pro Asn Gly Val Thr Ser Ser Glu Ser Ser Xaa Arg Thr
90 95 100

gtc ttc tgatgtgagc cttggcaccn gtg 432
Val Phe

<210> 48
<211> 103
<212> PRT
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<400> 48

Met Ser Xaa Gly Asp Asn Ala Pro Ile Asp Glu Asp Ala Phe Lys Asn
 1 5 10 15

Arg Val Leu Val Gly Phe Glu Ile Glu Ala Met Ser Asn Thr Cys Thr
 20 25 30

His Asn Leu Lys Ala Ala Thr Asp Gln Met Gly Ile Asp Asn Ile Asn
 35 40 45

Tyr Asp Phe Arg Pro Thr Gly Thr His Ala Trp Asp Tyr Trp Asn Glu
 50 55 60

Ala Leu His Arg Phe Phe Pro Leu Met Met Gln Gly Phe Gly Leu Asp
 65 70 75 80

Gly Gly Pro Ile Pro Ile Tyr Asn Pro Asn Gly Val Thr Ser Ser Glu
 85 90 95

Ser Ser Xaa Arg Thr Val Phe
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<210> 49

<211> 835

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(835)

<223> RXN03051

<400> 49

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ggaactcccg ctgcctaagc gggacatagt tgcaggggac atg cgt tca gat gtt 115
 Met Arg Ser Asp Val
 1 5

atc gag tta ccg gag ggg gta agc aag gag aaa gct gac cag cta gaa 163
 Ile Glu Leu Pro Glu Gly Val Ser Lys Glu Lys Ala Asp Gln Leu Glu
 10 15 20

gtt gcg gaa gcg cga ctt aac gag ggt gca cga ctg atg gca acc acc 211
 Val Ala Glu Ala Arg Leu Asn Glu Gly Ala Arg Leu Met Ala Thr Thr
 25 30 35

ggg tgt gag gtt atg tgg cca acg ggc ttc tca gtt tgt ggc cga att 259
 Gly Cys Glu Val Met Trp Pro Thr Gly Phe Ser Val Cys Gly Arg Ile
 40 45 50

ctt gac acc tat cgc cag gtt gga ggt cag ttg tca tgg ctt ggg cca 307
 Leu Asp Thr Tyr Arg Gln Val Gly Gly Gln Leu Ser Trp Leu Gly Pro
 55 60 65

ccg aag tca aac gag ttg acc aat ccc gac ggt gtt ggc aaa aga agt 355

Pro Lys Ser Asn Glu Leu Thr Asn Pro Asp Gly Val Gly Lys Arg Ser
 70 75 80 85

gaa ttt ttt ggt gga gcc atc tat tgg cac cca gac aca ggc gct tat 403
 Glu Phe Phe Gly Gly Ala Ile Tyr Trp His Pro Asp Thr Gly Ala Tyr
 90 95 100

gca gtg acc ttg gac ggt ttg cga cag tgg ggg acc ttg aac tgg gaa 451
 Ala Val Thr Leu Asp Gly Leu Arg Gln Trp Gly Thr Leu Asn Trp Glu
 105 110 115

tca ggg cca ttg ggg tac cca acc tct ggt ccg atg gat aca aac tat 499
 Ser Gly Pro Leu Gly Tyr Pro Thr Ser Gly Pro Met Asp Thr Asn Tyr
 120 125 130

ccc ctt act cag cga cag act ttt caa ggt ggt gac aac tac tac aac 547
 Pro Leu Thr Gln Arg Gln Thr Phe Gln Gly Gly Asp Asn Tyr Tyr Asn
 135 140 145

cca ttg act ggc ggt gct gtg tgg ggc gat att aaa cag cgc tac gaa 595
 Pro Leu Thr Gly Gly Ala Val Trp Gly Asp Ile Lys Gln Arg Tyr Glu
 150 155 160 165

gaa ctt ggc ggc tcg aat cat gcc att ggc atc ccg atc act aat gag 643
 Glu Leu Gly Gly Ser Asn His Ala Ile Gly Ile Pro Ile Thr Asn Glu
 170 175 180

cta cct agc ggt act gag tat ttt tac aat aat ttc tcc aat gga aca 691
 Leu Pro Ser Gly Thr Glu Tyr Phe Tyr Asn Asn Phe Ser Asn Gly Thr
 185 190 195

att tcg tgg cga aat gat cgt cag aca cgg ttt atg tat ttg gct acg 739
 Ile Ser Trp Arg Asn Asp Arg Gln Thr Arg Phe Met Tyr Leu Ala Thr
 200 205 210

cag cgg gtg tgg gat gcg ttg ggt cgg gag acg ggt cgt tta ggt ttt 787
 Gln Arg Val Trp Asp Ala Leu Gly Arg Glu Thr Gly Arg Leu Gly Phe
 215 220 225

cct gaa gca gat gaa aca cct gag gtt tct ggt cta ttc cat gtg gcg 835
 Pro Glu Ala Asp Glu Thr Pro Glu Val Ser Gly Leu Phe His Val Ala
 230 235 240 245

<210> 50

<211> 245

<212> PRT

<213> Corynebacterium glutamicum

<400> 50

Met Arg Ser Asp Val Ile Glu Leu Pro Glu Gly Val Ser Lys Glu Lys
 1 5 10 15

Ala Asp Gln Leu Glu Val Ala Glu Ala Arg Leu Asn Glu Gly Ala Arg
 20 25 30

Leu Met Ala Thr Thr Gly Cys Glu Val Met Trp Pro Thr Gly Phe Ser

| 35 | 40 | 45 |
|---|-----|---------|
| Val Cys Gly Arg Ile Leu Asp Thr Tyr Arg Gln Val Gly Gly Gln Leu | | |
| 50 | 55 | 60 |
| Ser Trp Leu Gly Pro Pro Lys Ser Asn Glu Leu Thr Asn Pro Asp Gly | | |
| 65 | 70 | 75 80 |
| Val Gly Lys Arg Ser Glu Phe Phe Gly Gly Ala Ile Tyr Trp His Pro | | |
| 85 | 90 | 95 |
| Asp Thr Gly Ala Tyr Ala Val Thr Leu Asp Gly Leu Arg Gln Trp Gly | | |
| 100 | 105 | 110 |
| Thr Leu Asn Trp Glu Ser Gly Pro Leu Gly Tyr Pro Thr Ser Gly Pro | | |
| 115 | 120 | 125 |
| Met Asp Thr Asn Tyr Pro Leu Thr Gln Arg Gln Thr Phe Gln Gly Gly | | |
| 130 | 135 | 140 |
| Asp Asn Tyr Tyr Asn Pro Leu Thr Gly Gly Ala Val Trp Gly Asp Ile | | |
| 145 | 150 | 155 160 |
| Lys Gln Arg Tyr Glu Glu Leu Gly Gly Ser Asn His Ala Ile Gly Ile | | |
| 165 | 170 | 175 |
| Pro Ile Thr Asn Glu Leu Pro Ser Gly Thr Glu Tyr Phe Tyr Asn Asn | | |
| 180 | 185 | 190 |
| Phe Ser Asn Gly Thr Ile Ser Trp Arg Asn Asp Arg Gln Thr Arg Phe | | |
| 195 | 200 | 205 |
| Met Tyr Leu Ala Thr Gln Arg Val Trp Asp Ala Leu Gly Arg Glu Thr | | |
| 210 | 215 | 220 |
| Gly Arg Leu Gly Phe Pro Glu Ala Asp Glu Thr Pro Glu Val Ser Gly | | |
| 225 | 230 | 235 240 |
| Leu Phe His Val Ala | | |
| 245 | | |

<210> 51
 <211> 1704
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1681)
 <223> RXN03054

<400> 51
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 cagtttggtc acatcaacta gtaacgaaag gatcatgtga atg aaa ctg ttt tcc 115
 Met Lys Leu Phe Ser

| | 1 | 5 | |
|---|-----|-----|-----|
| aag gct gca ggc gtc att gct gca gca ctt ctt gtt gca ggt ggt ata | | | 163 |
| Lys Ala Ala Gly Val Ile Ala Ala Ala Leu Leu Val Ala Gly Gly Ile | | | |
| | 10 | 15 | 20 |
| gca cct gtg gca cag ggg caa gct agt cag gtg gtc aca cct gaa gac | | | 211 |
| Ala Pro Val Ala Gln Gly Gln Ala Ser Gln Val Val Thr Pro Glu Asp | | | |
| | 25 | 30 | 35 |
| caa gat gcg tat gtt caa cag ttc cac cac gaa ggg aat acc cca cct | | | 259 |
| Gln Asp Ala Tyr Val Gln Gln Phe His His Glu Gly Asn Thr Pro Pro | | | |
| | 40 | 45 | 50 |
| gtg gta gac ggg gtg ggt ggc tac act gag caa gaa atc gcc gag atc | | | 307 |
| Val Val Asp Gly Val Gly Gly Tyr Thr Glu Gln Glu Ile Ala Glu Ile | | | |
| | 55 | 60 | 65 |
| cac gag gct atc cga caa gcc caa gaa tct ggc gca cct aat gaa gag | | | 355 |
| His Glu Ala Ile Arg Gln Ala Gln Glu Ser Gly Ala Pro Asn Glu Glu | | | |
| | 70 | 75 | 80 |
| ctc att ccg ggt gag atg tgg tca gat aag gtg gag ctg cca gta act | | | 403 |
| Leu Ile Pro Gly Glu Met Trp Ser Asp Lys Val Glu Leu Pro Val Thr | | | |
| | 90 | 95 | 100 |
| att gat aaa gca gcc gct gat gag gca gag ata gct att gca cag caa | | | 451 |
| Ile Asp Lys Ala Ala Ala Asp Glu Ala Glu Ile Ala Ile Ala Gln Gln | | | |
| | 105 | 110 | 115 |
| caa tct cag cca cag acg cga ggc ctt gct gcg gct gcg gcg tgt cag | | | 499 |
| Gln Ser Gln Pro Gln Thr Arg Gly Leu Ala Ala Ala Ala Ala Cys Gln | | | |
| | 120 | 125 | 130 |
| acg ttt tgg ccg tca cct cat cag gtt tgt ggt gct att tta gag cgc | | | 547 |
| Thr Phe Trp Pro Ser Pro His Gln Val Cys Gly Ala Ile Leu Glu Arg | | | |
| | 135 | 140 | 145 |
| tat att cag cag ggt gcc cag ttt ggg tgg atg ttg ttt ccg agt gaa | | | 595 |
| Tyr Ile Gln Gln Gly Ala Gln Phe Gly Trp Met Leu Phe Pro Ser Glu | | | |
| | 150 | 155 | 160 |
| ggc caa acg tta aat cct gat ggt cag ggg tat cgt cag cgg ttt atg | | | 643 |
| Gly Gln Thr Leu Asn Pro Asp Gly Gln Gly Tyr Arg Gln Arg Phe Met | | | |
| | 170 | 175 | 180 |
| aat ggg ttt gtt tat tgg cat ccg aca act ggt gcg cat gct gtt aat | | | 691 |
| Asn Gly Phe Val Tyr Trp His Pro Thr Thr Gly Ala His Ala Val Asn | | | |
| | 185 | 190 | 195 |
| aat tac agt gcg cag gtg tgg gag cgt aat ggg tgg gag tct ggg tgg | | | 739 |
| Asn Tyr Ser Ala Gln Val Trp Glu Arg Asn Gly Trp Glu Ser Gly Trp | | | |
| | 200 | 205 | 210 |
| atg ggt tat ccc act ggt ggt gaa gtc cct gtg aat ggt tcc aat ccg | | | 787 |
| Met Gly Tyr Pro Thr Gly Gly Glu Val Pro Val Asn Gly Ser Asn Pro | | | |
| | 215 | 220 | 225 |

| | |
|---|------|
| att gat ggt gag ttg agt ggg tgg gtg caa act ttc caa ggt ggg cga | 835 |
| Ile Asp Gly Glu Leu Ser Gly Trp Val Gln Thr Phe Gln Gly Gly Arg | |
| 230 235 240 245 | |
| gtg tat cgc agt ccg gta ttg gac ggt ttc cag gtg gcc agt att aat | 883 |
| Val Tyr Arg Ser Pro Val Leu Asp Gly Phe Gln Val Ala Ser Ile Asn | |
| 250 255 260 | |
| ggg ctg atc ttg gat aaa tgg ctt gaa ttg ggt ggt cct gat agt gac | 931 |
| Gly Leu Ile Leu Asp Lys Trp Leu Glu Leu Gly Gly Pro Asp Ser Asp | |
| 265 270 275 | |
| ctt ggt ttt ccc att gcg gat gag gct gtg aca gct gac ggt gtg ggt | 979 |
| Leu Gly Phe Pro Ile Ala Asp Glu Ala Val Thr Ala Asp Gly Val Gly | |
| 280 285 290 | |
| aga ttt tct gtt ttc cag aac gga gtt gtc tac tgg cat ccg caa cac | 1027 |
| Arg Phe Ser Val Phe Gln Asn Gly Val Val Tyr Trp His Pro Gln His | |
| 295 300 305 | |
| gga gct cac cct ata tta ggg aat ata tac agt atc tgg aga gaa gaa | 1075 |
| Gly Ala His Pro Ile Leu Gly Asn Ile Tyr Ser Ile Trp Arg Glu Glu | |
| 310 315 320 325 | |
| gga gct gag agt ggg gaa ttc ggt tac cct atc ggc gat cca gaa aag | 1123 |
| Gly Ala Glu Ser Gly Glu Phe Gly Tyr Pro Ile Gly Asp Pro Glu Lys | |
| 330 335 340 | |
| tat aca gaa aac atg gct aat cag gta ttc gaa aaa ggc gaa ctt gca | 1171 |
| Tyr Thr Glu Asn Met Ala Asn Gln Val Phe Glu Lys Gly Glu Leu Ala | |
| 345 350 355 | |
| gct aac cta tac ccc aat cct ctt gag gct ttt att gag ttt tta ccc | 1219 |
| Ala Asn Leu Tyr Pro Asn Pro Leu Glu Ala Phe Ile Glu Phe Leu Pro | |
| 360 365 370 | |
| ttt gct aat ctt gag gaa gca ata gag tat ttt gag aac gga ttg tca | 1267 |
| Phe Ala Asn Leu Glu Glu Ala Ile Glu Tyr Phe Glu Asn Gly Leu Ser | |
| 375 380 385 | |
| aat tct cgt gta gag gcg aat tca ctt aac gcc aag aaa gat tcg att | 1315 |
| Asn Ser Arg Val Glu Ala Asn Ser Leu Asn Ala Lys Lys Asp Ser Ile | |
| 390 395 400 405 | |
| caa tgt caa tcg caa tcc gct aac att cat gtg aga acg aag agt gac | 1363 |
| Gln Cys Gln Ser Gln Ser Ala Asn Ile His Val Arg Thr Lys Ser Asp | |
| 410 415 420 | |
| gga gtc ggg att agg gtt cca aag att ggg ttt aag gct agg atg gat | 1411 |
| Gly Val Gly Ile Arg Val Pro Lys Ile Gly Phe Lys Ala Arg Met Asp | |
| 425 430 435 | |
| tgc gac ctt cct gga act gtc tca gat gta gtg ggg tat gga tgg att | 1459 |
| Cys Asp Leu Pro Gly Thr Val Ser Asp Val Val Gly Tyr Gly Trp Ile | |
| 440 445 450 | |

tac tac gac tat tgg gga cga tgg gct caa gca gca tat gca caa caa 1507
 Tyr Tyr Asp Tyr Trp Gly Arg Trp Ala Gln Ala Ala Tyr Ala Gln Gln
 455 460 465

ttc ttc ggt aat agg aat tct gtt gtg caa acc aat tta gag gcg ggt 1555
 Phe Phe Gly Asn Arg Asn Ser Val Val Gln Thr Asn Leu Glu Ala Gly
 470 475 480 485

tgc agc ggg gag aag aat aca tta ttt tgg ggt act tca tat ttt cag 1603
 Cys Ser Gly Glu Lys Asn Thr Leu Phe Trp Gly Thr Ser Tyr Phe Gln
 490 495 500

gtg act tat gaa ggt cag ccg tat ttc ggt cag tca gca act aat tac 1651
 Val Thr Tyr Glu Gly Gln Pro Tyr Phe Gly Gln Ser Ala Thr Asn Tyr
 505 510 515

gct tat ctt ccg tgt acg ata gac cgt agt taacataagg aatggaatag 1701
 Ala Tyr Leu Pro Cys Thr Ile Asp Arg Ser
 520 525

gag 1704

<210> 52

<211> 527

<212> PRT

<213> Corynebacterium glutamicum

<400> 52

Met Lys Leu Phe Ser Lys Ala Ala Gly Val Ile Ala Ala Ala Leu Leu
 1 5 10 15

Val Ala Gly Gly Ile Ala Pro Val Ala Gln Gly Gln Ala Ser Gln Val
 20 25 30

Val Thr Pro Glu Asp Gln Asp Ala Tyr Val Gln Gln Phe His His Glu
 35 40 45

Gly Asn Thr Pro Pro Val Val Asp Gly Val Gly Gly Tyr Thr Glu Gln
 50 55 60

Glu Ile Ala Glu Ile His Glu Ala Ile Arg Gln Ala Gln Glu Ser Gly
 65 70 75 80

Ala Pro Asn Glu Glu Leu Ile Pro Gly Glu Met Trp Ser Asp Lys Val
 85 90 95

Glu Leu Pro Val Thr Ile Asp Lys Ala Ala Ala Asp Glu Ala Glu Ile
 100 105 110

Ala Ile Ala Gln Gln Gln Ser Gln Pro Gln Thr Arg Gly Leu Ala Ala
 115 120 125

Ala Ala Ala Cys Gln Thr Phe Trp Pro Ser Pro His Gln Val Cys Gly
 130 135 140

Ala Ile Leu Glu Arg Tyr Ile Gln Gln Gly Ala Gln Phe Gly Trp Met

| | | | |
|---|-----------------|---------------------------------|-----|
| 145 | 150 | 155 | 160 |
| Leu Phe Pro Ser | Glu Gly Gln Thr | Leu Asn Pro Asp Gly Gln Gly Tyr | |
| | 165 | 170 | 175 |
| Arg Gln Arg Phe Met Asn Gly Phe Val Tyr Trp His Pro Thr Thr Gly | | | |
| | 180 | 185 | 190 |
| Ala His Ala Val Asn Asn Tyr Ser Ala Gln Val Trp Glu Arg Asn Gly | | | |
| | 195 | 200 | 205 |
| Trp Glu Ser Gly Trp Met Gly Tyr Pro Thr Gly Gly Glu Val Pro Val | | | |
| | 210 | 215 | 220 |
| Asn Gly Ser Asn Pro Ile Asp Gly Glu Leu Ser Gly Trp Val Gln Thr | | | |
| | 225 | 230 | 235 |
| Phe Gln Gly Gly Arg Val Tyr Arg Ser Pro Val Leu Asp Gly Phe Gln | | | |
| | 245 | 250 | 255 |
| Val Ala Ser Ile Asn Gly Leu Ile Leu Asp Lys Trp Leu Glu Leu Gly | | | |
| | 260 | 265 | 270 |
| Gly Pro Asp Ser Asp Leu Gly Phe Pro Ile Ala Asp Glu Ala Val Thr | | | |
| | 275 | 280 | 285 |
| Ala Asp Gly Val Gly Arg Phe Ser Val Phe Gln Asn Gly Val Val Tyr | | | |
| | 290 | 295 | 300 |
| Trp His Pro Gln His Gly Ala His Pro Ile Leu Gly Asn Ile Tyr Ser | | | |
| | 305 | 310 | 315 |
| Ile Trp Arg Glu Glu Gly Ala Glu Ser Gly Glu Phe Gly Tyr Pro Ile | | | |
| | 325 | 330 | 335 |
| Gly Asp Pro Glu Lys Tyr Thr Glu Asn Met Ala Asn Gln Val Phe Glu | | | |
| | 340 | 345 | 350 |
| Lys Gly Glu Leu Ala Ala Asn Leu Tyr Pro Asn Pro Leu Glu Ala Phe | | | |
| | 355 | 360 | 365 |
| Ile Glu Phe Leu Pro Phe Ala Asn Leu Glu Glu Ala Ile Glu Tyr Phe | | | |
| | 370 | 375 | 380 |
| Glu Asn Gly Leu Ser Asn Ser Arg Val Glu Ala Asn Ser Leu Asn Ala | | | |
| | 385 | 390 | 395 |
| Lys Lys Asp Ser Ile Gln Cys Gln Ser Gln Ser Ala Asn Ile His Val | | | |
| | 405 | 410 | 415 |
| Arg Thr Lys Ser Asp Gly Val Gly Ile Arg Val Pro Lys Ile Gly Phe | | | |
| | 420 | 425 | 430 |
| Lys Ala Arg Met Asp Cys Asp Leu Pro Gly Thr Val Ser Asp Val Val | | | |
| | 435 | 440 | 445 |
| Gly Tyr Gly Trp Ile Tyr Tyr Asp Tyr Trp Gly Arg Trp Ala Gln Ala | | | |

| | | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <400> 53 | | | | | | | | | | | | | | | | |
| actctcgaag gttgaacaca gggctgcgat tgtgctggat caaatgtctg cacgaaaaat | | | | | | | | | | | | | | | | 60 |
| tgttatcgcc cctggatgag tagtgattta gaggagtgct | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | gtg | agc | gac | gag | cag | 115 |
| | | | | | | | | | | | Val | Ser | Asp | Glu | Gln | |
| | | | | | | | | | | | 1 | | | | 5 | |
| aat tct ggc gta ggc gga acg tct cgc cca acg ggt aaa cgc cag ctg | | | | | | | | | | | | | | | | 163 |
| Asn | Ser | Gly | Val | Gly | Gly | Thr | Ser | Arg | Pro | Thr | Gly | Lys | Arg | Gln | Leu | |
| | | | | 10 | | | | | 15 | | | | | 20 | | |
| tcg ggt gct tcc act acc tct acc tct tct tat gag gct aag cag gta | | | | | | | | | | | | | | | | 211 |
| Ser | Gly | Ala | Ser | Thr | Thr | Ser | Thr | Ser | Ser | Tyr | Glu | Ala | Lys | Gln | Val | |
| | | | 25 | | | | | 30 | | | | | 35 | | | |
| tct aca cag aag aag tca tcc ggt tcg gat tct aag cct ggc ggc ggt | | | | | | | | | | | | | | | | 259 |
| Ser | Thr | Gln | Lys | Lys | Ser | Ser | Gly | Ser | Asp | Ser | Lys | Pro | Gly | Gly | Gly | |
| | | 40 | | | | | 45 | | | | | 50 | | | | |
| gtt att tct ttt ctg cct gag gtt gtg gga gaa gtc cgt aag gtt att | | | | | | | | | | | | | | | | 307 |
| Val | Ile | Ser | Phe | Leu | Pro | Glu | Val | Val | Gly | Glu | Val | Arg | Lys | Val | Ile | |
| | 55 | | | | | 60 | | | | | 65 | | | | | |
| tgg cct act gcg cgc cag atg gtc acg tac acc ctt gtc gtt ttg gga | | | | | | | | | | | | | | | | 355 |
| Trp | Pro | Thr | Ala | Arg | Gln | Met | Val | Thr | Tyr | Thr | Leu | Val | Val | Leu | Gly | |
| 70 | | | | | 75 | | | | | 80 | | | | 85 | | |
| ttc ttg att gtt ttg acc gct ttg gtg tct ggt gtg gat ttc cta gct | | | | | | | | | | | | | | | | 403 |
| Phe | Leu | Ile | Val | Leu | Thr | Ala | Leu | Val | Ser | Gly | Val | Asp | Phe | Leu | Ala | |
| | | | | 90 | | | | | 95 | | | | | 100 | | |
| ggg ctt gga gtt gag aag att ctg act ccg taqgtaqqat gtgtaacatc | | | | | | | | | | | | | | | | 453 |

Gly Leu Gly Val Glu Lys Ile Leu Thr Pro
 105 110

ttt

456

<210> 54
 <211> 111
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 54
 Val Ser Asp Glu Gln Asn Ser Gly Val Gly Gly Thr Ser Arg Pro Thr
 1 5 10 15
 Gly Lys Arg Gln Leu Ser Gly Ala Ser Thr Thr Ser Thr Ser Ser Tyr
 20 25 30
 Glu Ala Lys Gln Val Ser Thr Gln Lys Lys Ser Ser Gly Ser Asp Ser
 35 40 45
 Lys Pro Gly Gly Gly Val Ile Ser Phe Leu Pro Glu Val Val Gly Glu
 50 55 60
 Val Arg Lys Val Ile Trp Pro Thr Ala Arg Gln Met Val Thr Tyr Thr
 65 70 75 80
 Leu Val Val Leu Gly Phe Leu Ile Val Leu Thr Ala Leu Val Ser Gly
 85 90 95
 Val Asp Phe Leu Ala Gly Leu Gly Val Glu Lys Ile Leu Thr Pro
 100 105 110

<210> 55
 <211> 1941
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1918)
 <223> RXN02462

<400> 55
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 atcgacgttc tacaacgtct tcgcacagat cgtcccacgc atg acc aag gac gtt 115
 Met Thr Lys Asp Val
 1 5
 cac tac gaa gtc gac gaa cgt aaa aag acc gtc ggt gtg aaa gaa gaa 163
 His Tyr Glu Val Asp Glu Arg Lys Lys Thr Val Gly Val Lys Glu Glu
 10 15 20
 ggc gtc gaa tac gtc gaa gac caa ctc ggc atc gac aac ctc tac gca 211
 Gly Val Glu Tyr Val Glu Asp Gln Leu Gly Ile Asp Asn Leu Tyr Ala

| | 25 | 30 | 35 | |
|---|-----|-----|-----|-----|
| cct gag cac tca cag ctg gtc agc tac ctg aac aac gcc atc aag gca | | | | 259 |
| Pro Glu His Ser Gln Leu Val Ser Tyr Leu Asn Asn Ala Ile Lys Ala | | | | |
| | 40 | 45 | 50 | |
| cag gaa ctg ttc acc cgc gac aag gac tac atc gtc cgc aac ggc gaa | | | | 307 |
| Gln Glu Leu Phe Thr Arg Asp Lys Asp Tyr Ile Val Arg Asn Gly Glu | | | | |
| | 55 | 60 | 65 | |
| gtt atg atc gtc gac ggc ttc acc ggc cgt gtc ctt gcc ggc cgc cga | | | | 355 |
| Val Met Ile Val Asp Gly Phe Thr Gly Arg Val Leu Ala Gly Arg Arg | | | | |
| | 70 | 75 | 80 | 85 |
| tac aac gaa ggc atg cac cag gcg atc gaa gcc aaa gag cgc gta gag | | | | 403 |
| Tyr Asn Glu Gly Met His Gln Ala Ile Glu Ala Lys Glu Arg Val Glu | | | | |
| | 90 | 95 | 100 | |
| atc aaa aac gag aac cag acc ctg gcg acc gtt acc ctc cag aac tac | | | | 451 |
| Ile Lys Asn Glu Asn Gln Thr Leu Ala Thr Val Thr Leu Gln Asn Tyr | | | | |
| | 105 | 110 | 115 | |
| ttc cgc ctc tac acc aaa ctc gcc ggc atg acc ggt acc gca gag acc | | | | 499 |
| Phe Arg Leu Tyr Thr Lys Leu Ala Gly Met Thr Gly Thr Ala Glu Thr | | | | |
| | 120 | 125 | 130 | |
| gaa gca gca gag ctc aac cag atc tac aag ctc gac gtc atc gcg atc | | | | 547 |
| Glu Ala Ala Glu Leu Asn Gln Ile Tyr Lys Leu Asp Val Ile Ala Ile | | | | |
| | 135 | 140 | 145 | |
| cca acc aac cga cca aac cag cgc gaa gac ttg acc gac ttg gtg tac | | | | 595 |
| Pro Thr Asn Arg Pro Asn Gln Arg Glu Asp Leu Thr Asp Leu Val Tyr | | | | |
| | 150 | 155 | 160 | 165 |
| aaa acc caa gag gct aag ttc gca gca gtc gtc gac gac atc gca gaa | | | | 643 |
| Lys Thr Gln Glu Ala Lys Phe Ala Ala Val Val Asp Asp Ile Ala Glu | | | | |
| | 170 | 175 | 180 | |
| cgc acc gaa aag ggc caa cca gtc ctc gtc ggt acc gtc tcc gtc gag | | | | 691 |
| Arg Thr Glu Lys Gly Gln Pro Val Leu Val Gly Thr Val Ser Val Glu | | | | |
| | 185 | 190 | 195 | |
| cgc tcc gaa tac ctc tcc cag ctg ttg acc aaa cga ggc atc aag cac | | | | 739 |
| Arg Ser Glu Tyr Leu Ser Gln Leu Leu Thr Lys Arg Gly Ile Lys His | | | | |
| | 200 | 205 | 210 | |
| aac gtc ctc aat gcg aag cac cac gag cag gaa gca cag atc gtt gct | | | | 787 |
| Asn Val Leu Asn Ala Lys His His Glu Gln Glu Ala Gln Ile Val Ala | | | | |
| | 215 | 220 | 225 | |
| cag gca ggt ctt cca ggc gcc gtc acc gtt gcc acc aac atg gcg ggc | | | | 835 |
| Gln Ala Gly Leu Pro Gly Ala Val Thr Val Ala Thr Asn Met Ala Gly | | | | |
| | 230 | 235 | 240 | 245 |
| cgt gga acc gac atc gtg ctc ggc gga aac cca gaa atc ctc ctc gac | | | | 883 |
| Arg Gly Thr Asp Ile Val Leu Gly Gly Asn Pro Glu Ile Leu Leu Asp | | | | |
| | 250 | 255 | 260 | |

| | |
|---|------|
| atc aaa ctc cgc gaa cgt gga ctt gat cct ttc gaa gac gaa gaa agc | 931 |
| Ile Lys Leu Arg Glu Arg Gly Leu Asp Pro Phe Glu Asp Glu Glu Ser | |
| 265 270 275 | |
| tac cag gaa gcc tgg gac gct gaa ctt cca gca atg aag cag cga tgc | 979 |
| Tyr Gln Glu Ala Trp Asp Ala Glu Leu Pro Ala Met Lys Gln Arg Cys | |
| 280 285 290 | |
| gaa gaa cgt ggc gac aaa gtc cgc gaa gcc gga gga ctc tac gtc ctt | 1027 |
| Glu Glu Arg Gly Asp Lys Val Arg Glu Ala Gly Gly Leu Tyr Val Leu | |
| 295 300 305 | |
| ggc acc gaa cgc cac gaa tcc cga cgc atc gac aac cag ctg cgc ggt | 1075 |
| Gly Thr Glu Arg His Glu Ser Arg Arg Ile Asp Asn Gln Leu Arg Gly | |
| 310 315 320 325 | |
| cgt tct gca cgt cag ggc gac cca gga tcc acc cgc ttc tat ctc tct | 1123 |
| Arg Ser Ala Arg Gln Gly Asp Pro Gly Ser Thr Arg Phe Tyr Leu Ser | |
| 330 335 340 | |
| atg cgc gac gac ctg atg gtt cgc ttc gtc ggc cca acc atg gaa aac | 1171 |
| Met Arg Asp Asp Leu Met Val Arg Phe Val Gly Pro Thr Met Glu Asn | |
| 345 350 355 | |
| atg atg aac agg ctc aac gtc cca gac gat gtg ccc atc gaa tcc aaa | 1219 |
| Met Met Asn Arg Leu Asn Val Pro Asp Asp Val Pro Ile Glu Ser Lys | |
| 360 365 370 | |
| acc gtc acc aac tcc atc aag ggc gcc caa gct cag gtg gag aac cag | 1267 |
| Thr Val Thr Asn Ser Ile Lys Gly Ala Gln Ala Gln Val Glu Asn Gln | |
| 375 380 385 | |
| aac ttc gaa atg cgt aag aac gtt ctg aag tac gac gaa gtc atg aac | 1315 |
| Asn Phe Glu Met Arg Lys Asn Val Leu Lys Tyr Asp Glu Val Met Asn | |
| 390 395 400 405 | |
| gaa cag cgc aag gtt atc tac agc gag cga cgc gaa atc ctc gaa tcc | 1363 |
| Glu Gln Arg Lys Val Ile Tyr Ser Glu Arg Arg Glu Ile Leu Glu Ser | |
| 410 415 420 | |
| gca gac atc tcc cgc tac atc caa aac atg atc gaa gaa aca gtc agc | 1411 |
| Ala Asp Ile Ser Arg Tyr Ile Gln Asn Met Ile Glu Glu Thr Val Ser | |
| 425 430 435 | |
| gca tac gtc gac ggc gcc acc gcc aac ggc tac gtc gaa gac tgg gac | 1459 |
| Ala Tyr Val Asp Gly Ala Thr Ala Asn Gly Tyr Val Glu Asp Trp Asp | |
| 440 445 450 | |
| ctc gac aaa ctc tgg aac gcc ctc gaa gcc ctc tac gac cca tcg atc | 1507 |
| Leu Asp Lys Leu Trp Asn Ala Leu Glu Ala Leu Tyr Asp Pro Ser Ile | |
| 455 460 465 | |
| aac tgg acc gac ctc gtc gaa ggc agc gaa tac ggc aaa cca ggg gag | 1555 |
| Asn Trp Thr Asp Leu Val Glu Gly Ser Glu Tyr Gly Lys Pro Gly Glu | |
| 470 475 480 485 | |

ctg tcc gcc gaa gat cta cgc acc gca ctc gtc aac gac gcc cac gcc 1603
 Leu Ser Ala Glu Asp Leu Arg Thr Ala Leu Val Asn Asp Ala His Ala
 490 495 500

gaa tac gca aaa ctc gaa gaa gcc gta tcc gca atc ggc ggc gaa gca 1651
 Glu Tyr Ala Lys Leu Glu Glu Ala Val Ser Ala Ile Gly Gly Glu Ala
 505 510 515

cag atc cgc aac atc gaa cga atg gtg ctc atg cca gtc atc gac acc 1699
 Gln Ile Arg Asn Ile Glu Arg Met Val Leu Met Pro Val Ile Asp Thr
 520 525 530

aaa tgg cgc gaa cac ctc tac gaa atg gac tac ctg aaa gaa ggc atc 1747
 Lys Trp Arg Glu His Leu Tyr Glu Met Asp Tyr Leu Lys Glu Gly Ile
 535 540 545

ggc ctg cgc gca atg gca cag cgc gac cca ctg gtc gaa tac caa aag 1795
 Gly Leu Arg Ala Met Ala Gln Arg Asp Pro Leu Val Glu Tyr Gln Lys
 550 555 560 565

gaa ggc ggc gac atg ttc aac ggc atg aaa gac ggc atc aag gaa gaa 1843
 Glu Gly Gly Asp Met Phe Asn Gly Met Lys Asp Gly Ile Lys Glu Glu
 570 575 580

acc gtc cgc cag ctc ttc ctc tcc gca agc agt tca tca agc aag acg 1891
 Thr Val Arg Gln Leu Phe Leu Ser Ala Ser Ser Ser Ser Ser Lys Thr
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cgg aag tcg ctg act aac tca gaa ccc tgaaattcag catccgccac 1938
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 600 605

atg 1941

<210> 56
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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 56
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Gly Val Lys Glu Glu Gly Val Glu Tyr Val Glu Asp Gln Leu Gly Ile
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Asp Asn Leu Tyr Ala Pro Glu His Ser Gln Leu Val Ser Tyr Leu Asn
 35 40 45

Asn Ala Ile Lys Ala Gln Glu Leu Phe Thr Arg Asp Lys Asp Tyr Ile
 50 55 60

Val Arg Asn Gly Glu Val Met Ile Val Asp Gly Phe Thr Gly Arg Val
 65 70 75 80

Leu Ala Gly Arg Arg Tyr Asn Glu Gly Met His Gln Ala Ile Glu Ala

88

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385          390          395          400
Asp Glu Val Met Asn Glu Gln Arg Lys Val Ile Tyr Ser Glu Arg Arg
          405          410          415
Glu Ile Leu Glu Ser Ala Asp Ile Ser Arg Tyr Ile Gln Asn Met Ile
          420          425          430
Glu Glu Thr Val Ser Ala Tyr Val Asp Gly Ala Thr Ala Asn Gly Tyr
          435          440          445
Val Glu Asp Trp Asp Leu Asp Lys Leu Trp Asn Ala Leu Glu Ala Leu
          450          455          460
Tyr Asp Pro Ser Ile Asn Trp Thr Asp Leu Val Glu Gly Ser Glu Tyr
          465          470          475          480
Gly Lys Pro Gly Glu Leu Ser Ala Glu Asp Leu Arg Thr Ala Leu Val
          485          490          495
Asn Asp Ala His Ala Glu Tyr Ala Lys Leu Glu Glu Ala Val Ser Ala
          500          505          510
Ile Gly Gly Glu Ala Gln Ile Arg Asn Ile Glu Arg Met Val Leu Met
          515          520          525
Pro Val Ile Asp Thr Lys Trp Arg Glu His Leu Tyr Glu Met Asp Tyr
          530          535          540
Leu Lys Glu Gly Ile Gly Leu Arg Ala Met Ala Gln Arg Asp Pro Leu
          545          550          555          560
Val Glu Tyr Gln Lys Glu Gly Gly Asp Met Phe Asn Gly Met Lys Asp
          565          570          575
Gly Ile Lys Glu Glu Thr Val Arg Gln Leu Phe Leu Ser Ala Ser Ser
          580          585          590
Ser Ser Ser Lys Thr Arg Lys Ser Leu Thr Asn Ser Glu Pro
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<210> 57
 <211> 1965
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1942)
 <223> RXN01559

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 cgcctgggaa cgatggccaa aacgcgcaat agcgttggtt gtg ctc atc gtc gtt 115
 Val Leu Ile Val Val

1

5

| | |
|---|-----|
| ggt gtt tat gcg ttg gtg ctg ttg aca ggc gat cgt tct gcc aca cca | 163 |
| Gly Val Tyr Ala Leu Val Leu Leu Thr Gly Asp Arg Ser Ala Thr Pro | |
| 10 15 20 | |
| aaa ttg ggt att gat ctg caa ggc gga acc cga gtg acc ctc gtg ccg | 211 |
| Lys Leu Gly Ile Asp Leu Gln Gly Gly Thr Arg Val Thr Leu Val Pro | |
| 25 30 35 | |
| cag ggg cag gat cca act cag gac cag ctg aat cag gca cgc acc att | 259 |
| Gln Gly Gln Asp Pro Thr Gln Asp Gln Leu Asn Gln Ala Arg Thr Ile | |
| 40 45 50 | |
| ctg gaa aac cgt gtg aac ggc atg ggc gtt tca ggt gca agc gtg gtc | 307 |
| Leu Glu Asn Arg Val Asn Gly Met Gly Val Ser Gly Ala Ser Val Val | |
| 55 60 65 | |
| gct gac ggt aac acg ctg gtg atc act gtt ccc ggg gaa aat acc gca | 355 |
| Ala Asp Gly Asn Thr Leu Val Ile Thr Val Pro Gly Glu Asn Thr Ala | |
| 70 75 80 85 | |
| cag gcg caa tcc cta gga cag acc tcc cag ctg ctg ttc cgt ccc gtt | 403 |
| Gln Ala Gln Ser Leu Gly Gln Thr Ser Gln Leu Leu Phe Arg Pro Val | |
| 90 95 100 | |
| ggt cag gca gga atg ccc gat atg acc acg ttg atg cca gag ctg gaa | 451 |
| Gly Gln Ala Gly Met Pro Asp Met Thr Thr Leu Met Pro Glu Leu Glu | |
| 105 110 115 | |
| gag atg gcc aac agg tgg gtt gaa tac ggc gtc atc acc gaa gag cag | 499 |
| Glu Met Ala Asn Arg Trp Val Glu Tyr Gly Val Ile Thr Glu Glu Gln | |
| 120 125 130 | |
| gca aat gcc tcc ttg gag gaa atg aac acc gct gtt gca tcg acc act | 547 |
| Ala Asn Ala Ser Leu Glu Glu Met Asn Thr Ala Val Ala Ser Thr Thr | |
| 135 140 145 | |
| gcg gtg gaa ggc gaa gaa gca act gag cca gaa ccc gtc acc gtg tcg | 595 |
| Ala Val Glu Gly Glu Glu Ala Thr Glu Pro Glu Pro Val Thr Val Ser | |
| 150 155 160 165 | |
| gcg acc cct atg gat gag cca gcc aac tcc att gag gca aca cag cga | 643 |
| Ala Thr Pro Met Asp Glu Pro Ala Asn Ser Ile Glu Ala Thr Gln Arg | |
| 170 175 180 | |
| cgc cag gaa atc acg gac atg ctg cgc acc gac cgc cag tcc acc gat | 691 |
| Arg Gln Glu Ile Thr Asp Met Leu Arg Thr Asp Arg Gln Ser Thr Asp | |
| 185 190 195 | |
| ccc act gtc cag atc gct gca agt tct ttg atg cag tgc acc act gat | 739 |
| Pro Thr Val Gln Ile Ala Ala Ser Ser Leu Met Gln Cys Thr Thr Asp | |
| 200 205 210 | |
| gag atg gat cct ttg gcc ggc acc gat gat cca cgc ctg cca ttg gtg | 787 |
| Glu Met Asp Pro Leu Ala Gly Thr Asp Asp Pro Arg Leu Pro Leu Val | |
| 215 220 225 | |

| | |
|---|------|
| gca tgt gat cca gct gta ggt ggc gtg tat gta ctt gat cct gca cct | 835 |
| Ala Cys Asp Pro Ala Val Gly Gly Val Tyr Val Leu Asp Pro Ala Pro | |
| 230 235 240 245 | |
| ttg ctc aac ggc gaa acc gat gag gaa aat ggt gcg cgc cta acc ggt | 883 |
| Leu Leu Asn Gly Glu Thr Asp Glu Glu Asn Gly Ala Arg Leu Thr Gly | |
| 250 255 260 | |
| aat gag atc gat acc aac cgt ccc atc acc ggt gga ttc aac gcc cag | 931 |
| Asn Glu Ile Asp Thr Asn Arg Pro Ile Thr Gly Gly Phe Asn Ala Gln | |
| 265 270 275 | |
| tcc ggc cag atg gaa atc agc ttt gcc ttc aaa tcc ggc gat ggg gaa | 979 |
| Ser Gly Gln Met Glu Ile Ser Phe Ala Phe Lys Ser Gly Asp Gly Glu | |
| 280 285 290 | |
| gaa ggc tct gca act tgg tcc tct ctg acc agc cag tac ctg cag cag | 1027 |
| Glu Gly Ser Ala Thr Trp Ser Ser Leu Thr Ser Gln Tyr Leu Gln Gln | |
| 295 300 305 | |
| cag atc gcc atc acc ctg gac tct cag gtg att tct gca ccc gtg att | 1075 |
| Gln Ile Ala Ile Thr Leu Asp Ser Gln Val Ile Ser Ala Pro Val Ile | |
| 310 315 320 325 | |
| cag tca gca acc cct gtg ggt tct gca aca tcc atc acc ggt gac ttc | 1123 |
| Gln Ser Ala Thr Pro Val Gly Ser Ala Thr Ser Ile Thr Gly Asp Phe | |
| 330 335 340 | |
| act caa act gaa gcc caa gat ctg gcg aac aac ctg cgc tac ggt gca | 1171 |
| Thr Gln Thr Glu Ala Gln Asp Leu Ala Asn Asn Leu Arg Tyr Gly Ala | |
| 345 350 355 | |
| ttg ccc ctg agc ttc gca ggt gaa aac ggc gag cgc ggc gga act acc | 1219 |
| Leu Pro Leu Ser Phe Ala Gly Glu Asn Gly Glu Arg Gly Gly Thr Thr | |
| 360 365 370 | |
| acc acc gtt ccg cca tca cta ggc gca gca tcc ttg aag gcc gga ctg | 1267 |
| Thr Thr Val Pro Pro Ser Leu Gly Ala Ala Ser Leu Lys Ala Gly Leu | |
| 375 380 385 | |
| atc gca ggc atc gtc ggc atc gcg ctg gtc gcc atc ttc gtg ttc gcc | 1315 |
| Ile Ala Gly Ile Val Gly Ile Ala Leu Val Ala Ile Phe Val Phe Ala | |
| 390 395 400 405 | |
| tac tac cgc gtc ttc gga ttc gtt tcc ctg ttc acc ctg ttt gcc gca | 1363 |
| Tyr Tyr Arg Val Phe Gly Phe Val Ser Leu Phe Thr Leu Phe Ala Ala | |
| 410 415 420 | |
| ggc gtg ttg gtc tac ggc ctt ctg gta ctg ctg gga cgc tgg atc gga | 1411 |
| Gly Val Leu Val Tyr Gly Leu Leu Val Leu Leu Gly Arg Trp Ile Gly | |
| 425 430 435 | |
| tat tcc cta gac ctt gct ggt atc gcc ggt ttg atc atc ggt atc ggt | 1459 |
| Tyr Ser Leu Asp Leu Ala Gly Ile Ala Gly Leu Ile Ile Gly Ile Gly | |
| 440 445 450 | |

acc acc gcc gac tcc ttc gtg gtg ttc tat gag cgc atc aag gat gag 1507
 Thr Thr Ala Asp Ser Phe Val Val Phe Tyr Glu Arg Ile Lys Asp Glu
 455 460 465

atc cgt gaa gga aga tcc ttt aga tct gca gta cct cgt gca tgg gaa 1555
 Ile Arg Glu Gly Arg Ser Phe Arg Ser Ala Val Pro Arg Ala Trp Glu
 470 475 480 485

agc gcc aag cgc acc atc gtc aca ggc aac atg gtc act ttg ctc ggc 1603
 Ser Ala Lys Arg Thr Ile Val Thr Gly Asn Met Val Thr Leu Leu Gly
 490 495 500

gct atc gtg att tac ttg ctc gcg gtc ggc gaa gtc aag ggc ttt gcc 1651
 Ala Ile Val Ile Tyr Leu Leu Ala Val Gly Glu Val Lys Gly Phe Ala
 505 510 515

ttc acc ctg ggt ctg acc acc gta ttc gat ctc gtt gtc acc ttc ctg 1699
 Phe Thr Leu Gly Leu Thr Thr Val Phe Asp Leu Val Val Thr Phe Leu
 520 525 530

atc acg gca cca ctg gtt atc ctg gca tca cgc aac cca ttc ttt gcc 1747
 Ile Thr Ala Pro Leu Val Ile Leu Ala Ser Arg Asn Pro Phe Phe Ala
 535 540 545

aag tca tcg gtc aac ggc atg gga cga gtg atg aag ctc gtt gaa gaa 1795
 Lys Ser Ser Val Asn Gly Met Gly Arg Val Met Lys Leu Val Glu Glu
 550 555 560 565

cgc cgc gcc aac ggt gaa ttg gat gag cct gag tac ctg aaa aag atc 1843
 Arg Arg Ala Asn Gly Glu Leu Asp Glu Pro Glu Tyr Leu Lys Lys Ile
 570 575 580

cat gcc aag aat gcg gca gct gat aag gct tcc act gac aat tct tcc 1891
 His Ala Lys Asn Ala Ala Ala Asp Lys Ala Ser Thr Asp Asn Ser Ser
 585 590 595

act gac aat tct gaa gca cct ggc acc gat acg aac caa gag gag gag 1939
 Thr Asp Asn Ser Glu Ala Pro Gly Thr Asp Thr Asn Gln Glu Glu Glu
 600 605 610

aag tagccatgac tgattcccag act 1965
 Lys

<210> 58
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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 58
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| | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Thr | Leu | Val | Pro | Gln | Gly | Gln | Asp | Pro | Thr | Gln | Asp | Gln | Leu | Asn | 35 | 40 | 45 |
| Gln | Ala | Arg | Thr | Ile | Leu | Glu | Asn | Arg | Val | Asn | Gly | Met | Gly | Val | Ser | 50 | 55 | 60 |
| Gly | Ala | Ser | Val | Val | Ala | Asp | Gly | Asn | Thr | Leu | Val | Ile | Thr | Val | Pro | 65 | 70 | 75 |
| Gly | Glu | Asn | Thr | Ala | Gln | Ala | Gln | Ser | Leu | Gly | Gln | Thr | Ser | Gln | Leu | 85 | 90 | 95 |
| Leu | Phe | Arg | Pro | Val | Gly | Gln | Ala | Gly | Met | Pro | Asp | Met | Thr | Thr | Leu | 100 | 105 | 110 |
| Met | Pro | Glu | Leu | Glu | Glu | Met | Ala | Asn | Arg | Trp | Val | Glu | Tyr | Gly | Val | 115 | 120 | 125 |
| Ile | Thr | Glu | Glu | Gln | Ala | Asn | Ala | Ser | Leu | Glu | Glu | Met | Asn | Thr | Ala | 130 | 135 | 140 |
| Val | Ala | Ser | Thr | Thr | Ala | Val | Glu | Gly | Glu | Glu | Ala | Thr | Glu | Pro | Glu | 145 | 150 | 155 |
| Pro | Val | Thr | Val | Ser | Ala | Thr | Pro | Met | Asp | Glu | Pro | Ala | Asn | Ser | Ile | 165 | 170 | 175 |
| Glu | Ala | Thr | Gln | Arg | Arg | Gln | Glu | Ile | Thr | Asp | Met | Leu | Arg | Thr | Asp | 180 | 185 | 190 |
| Arg | Gln | Ser | Thr | Asp | Pro | Thr | Val | Gln | Ile | Ala | Ala | Ser | Ser | Leu | Met | 195 | 200 | 205 |
| Gln | Cys | Thr | Thr | Asp | Glu | Met | Asp | Pro | Leu | Ala | Gly | Thr | Asp | Asp | Pro | 210 | 215 | 220 |
| Arg | Leu | Pro | Leu | Val | Ala | Cys | Asp | Pro | Ala | Val | Gly | Gly | Val | Tyr | Val | 225 | 230 | 235 |
| Leu | Asp | Pro | Ala | Pro | Leu | Leu | Asn | Gly | Glu | Thr | Asp | Glu | Glu | Asn | Gly | 245 | 250 | 255 |
| Ala | Arg | Leu | Thr | Gly | Asn | Glu | Ile | Asp | Thr | Asn | Arg | Pro | Ile | Thr | Gly | 260 | 265 | 270 |
| Gly | Phe | Asn | Ala | Gln | Ser | Gly | Gln | Met | Glu | Ile | Ser | Phe | Ala | Phe | Lys | 275 | 280 | 285 |
| Ser | Gly | Asp | Gly | Glu | Glu | Gly | Ser | Ala | Thr | Trp | Ser | Ser | Leu | Thr | Ser | 290 | 295 | 300 |
| Gln | Tyr | Leu | Gln | Gln | Gln | Ile | Ala | Ile | Thr | Leu | Asp | Ser | Gln | Val | Ile | 305 | 310 | 315 |
| Ser | Ala | Pro | Val | Ile | Gln | Ser | Ala | Thr | Pro | Val | Gly | Ser | Ala | Thr | Ser | 325 | 330 | 335 |

Ile Thr Gly Asp Phe Thr Gln Thr Glu Ala Gln Asp Leu Ala Asn Asn
 340 345 350
 Leu Arg Tyr Gly Ala Leu Pro Leu Ser Phe Ala Gly Glu Asn Gly Glu
 355 360 365
 Arg Gly Gly Thr Thr Thr Thr Val Pro Pro Ser Leu Gly Ala Ala Ser
 370 375 380
 Leu Lys Ala Gly Leu Ile Ala Gly Ile Val Gly Ile Ala Leu Val Ala
 385 390 395 400
 Ile Phe Val Phe Ala Tyr Tyr Arg Val Phe Gly Phe Val Ser Leu Phe
 405 410 415
 Thr Leu Phe Ala Ala Gly Val Leu Val Tyr Gly Leu Leu Val Leu Leu
 420 425 430
 Gly Arg Trp Ile Gly Tyr Ser Leu Asp Leu Ala Gly Ile Ala Gly Leu
 435 440 445
 Ile Ile Gly Ile Gly Thr Thr Ala Asp Ser Phe Val Val Phe Tyr Glu
 450 455 460
 Arg Ile Lys Asp Glu Ile Arg Glu Gly Arg Ser Phe Arg Ser Ala Val
 465 470 475 480
 Pro Arg Ala Trp Glu Ser Ala Lys Arg Thr Ile Val Thr Gly Asn Met
 485 490 495
 Val Thr Leu Leu Gly Ala Ile Val Ile Tyr Leu Leu Ala Val Gly Glu
 500 505 510
 Val Lys Gly Phe Ala Phe Thr Leu Gly Leu Thr Thr Val Phe Asp Leu
 515 520 525
 Val Val Thr Phe Leu Ile Thr Ala Pro Leu Val Ile Leu Ala Ser Arg
 530 535 540
 Asn Pro Phe Phe Ala Lys Ser Ser Val Asn Gly Met Gly Arg Val Met
 545 550 555 560
 Lys Leu Val Glu Glu Arg Arg Ala Asn Gly Glu Leu Asp Glu Pro Glu
 565 570 575
 Tyr Leu Lys Lys Ile His Ala Lys Asn Ala Ala Ala Asp Lys Ala Ser
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<211> 819

<212> DNA

<213> Corynebacterium glutamicum

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<222> (101)..(796)

<223> RXN00046

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Met Asp Leu Asn Thr
1 5

caa cgc tca aag ctc tac gca cag ctt caa ggc cag ctc att gtt tcc 163
Gln Arg Ser Lys Leu Tyr Ala Gln Leu Gln Gly Gln Leu Ile Val Ser
10 15 20

gtg caa gct ccc gac ggc cat gcc atg cga gat acc cat acg ctc acc 211
Val Gln Ala Pro Asp Gly His Ala Met Arg Asp Thr His Thr Leu Thr
25 30 35

cat gtg gcc gca gcc tgt gtc gat ggc ggt gct cct gcc att cgc tgt 259
His Val Ala Ala Ala Cys Val Asp Gly Gly Ala Pro Ala Ile Arg Cys
40 45 50

ggc ggt tac ggc ggt ttg gaa gat atc cgt tca atc tcc aac cgt gtc 307
Gly Gly Tyr Gly Gly Leu Glu Asp Ile Arg Ser Ile Ser Asn Arg Val
55 60 65

gac gtt ccc gtt ttc gga ctc acc aaa gaa ggc tcc gaa gga gtt tac 355
Asp Val Pro Val Phe Gly Leu Thr Lys Glu Gly Ser Glu Gly Val Tyr
70 75 80 85

atc acc cca acc agg gat tcc gtt cga gca gtg gca gaa tcc ggc gcc 403
Ile Thr Pro Thr Arg Asp Ser Val Arg Ala Val Ala Glu Ser Gly Ala
90 95 100

act gta gtc tgc gcg gat gca act ttc cga cct agg cct gac ggc tcc 451
Thr Val Val Cys Ala Asp Ala Thr Phe Arg Pro Arg Pro Asp Gly Ser
105 110 115

acc ttt gca gag ctg gtc act gtt gcc cac gat tcc gga att ctc atc 499
Thr Phe Ala Glu Leu Val Thr Val Ala His Asp Ser Gly Ile Leu Ile
120 125 130

atg gcg gac tgc gca act ccc gaa gaa gtt ctc agt gcg cat aag gct 547
Met Ala Asp Cys Ala Thr Pro Glu Glu Val Leu Ser Ala His Lys Ala
135 140 145

ggc gcg gat ttt gtg tcc acc acg ctt gct gga tac acc gaa cac cgc 595
Gly Ala Asp Phe Val Ser Thr Thr Leu Ala Gly Tyr Thr Glu His Arg
150 155 160 165

gag aaa aca gtc ggt cca gat ttc gat tgc ctc cgc gaa gca cgt gag 643
Glu Lys Thr Val Gly Pro Asp Phe Asp Cys Leu Arg Glu Ala Arg Glu

[illegible]

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<212> PRT
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Thr His Thr Leu Thr His Val Ala Ala Ala Cys Val Asp Gly Gly Ala
      35                               40                      45

Pro Ala Ile Arg Cys Gly Gly Tyr Gly Gly Leu Glu Asp Ile Arg Ser
      50                      55                      60

Ile Ser Asn Arg Val Asp Val Pro Val Phe Gly Leu Thr Lys Glu Gly
  65                      70                      75                      80

Ser Glu Gly Val Tyr Ile Thr Pro Thr Arg Asp Ser Val Arg Ala Val
      85                               90                      95

Ala Glu Ser Gly Ala Thr Val Val Cys Ala Asp Ala Thr Phe Arg Pro
      100                      105                      110

Arg Pro Asp Gly Ser Thr Phe Ala Glu Leu Val Thr Val Ala His Asp
      115                      120                      125

Ser Gly Ile Leu Ile Met Ala Asp Cys Ala Thr Pro Glu Glu Val Leu
      130                      135                      140

Ser Ala His Lys Ala Gly Ala Asp Phe Val Ser Thr Thr Leu Ala Gly
  145                      150                      155                      160

Tyr Thr Glu His Arg Glu Lys Thr Val Gly Pro Asp Phe Asp Cys Leu
      165                      170                      175

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Arg Glu Ala Arg Glu Leu Val Pro Asp Ala Phe Leu Ile Gly Glu Gly
 180 185 190

Arg Phe Ser Asn Pro Ala Asp Val Ala His Gly Arg Leu Ile Gly Ala
 195 200 205

Asn Ala Ile Ile Val Gly Thr Ala Ile Thr Asp Pro Gly Phe Ile Thr
 210 215 220

Gly Gln Phe Ala Ser Leu Leu His
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<210> 61
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 <222> (48)..(1196)
 <223> RXN01863

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 Met Asn Ser
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 Val Lys Leu Lys Gln Pro Val Ser Ile Tyr Asn Asp Pro Trp Glu Ser
 5 10 15

tat aac gat gtt aaa gaa cat ggc caa tta act tta agt aac atc gaa 152
 Tyr Asn Asp Val Lys Glu His Gly Gln Leu Thr Leu Ser Asn Ile Glu
 20 25 30 35

ttt aca act aca aat ctt tgt aat atg cgt tgt agc cac tgt gca gtt 200
 Phe Thr Thr Thr Asn Leu Cys Asn Met Arg Cys Ser His Cys Ala Val
 40 45 50

ggt tat act tta caa act gtc gac ccc gag cct tta gat atg gac tta 248
 Gly Tyr Thr Leu Gln Thr Val Asp Pro Glu Pro Leu Asp Met Asp Leu
 55 60 65

att tat cgt aga ctt gat gaa att cca aat ctg cga acg atg tca att 296
 Ile Tyr Arg Arg Leu Asp Glu Ile Pro Asn Leu Arg Thr Met Ser Ile
 70 75 80

aca ggt ggc gaa cca atg ttt tct aaa aag tct att aga aat gtt gtt 344
 Thr Gly Gly Glu Pro Met Phe Ser Lys Lys Ser Ile Arg Asn Val Val
 85 90 95

aaa cct cta tta aag tat gca cat cat cga ggt ata tat aca caa atg 392
 Lys Pro Leu Leu Lys Tyr Ala His His Arg Gly Ile Tyr Thr Gln Met
 100 105 110 115

| | |
|---|------|
| aat tca aac cta aca ttg cct caa gat cgt tat tta gat att gct gaa Asn Ser Asn Leu Thr Leu Pro Gln Asp Arg Tyr Leu Asp Ile Ala Glu 120 125 130 | 440 |
| tat atc gat gtt atg cat atc tca cat aac tgg gga aca act gat gaa Tyr Ile Asp Val Met His Ile Ser His Asn Trp Gly Thr Thr Asp Glu 135 140 145 | 488 |
| ttc gca aat gtt ggc ttt ggc gca atg aag aag caa cca ccg tta aaa Phe Ala Asn Val Gly Phe Gly Ala Met Lys Lys Gln Pro Pro Leu Lys 150 155 160 | 536 |
| gct aag tta aaa tta tat gaa caa atg att tcg aat gca cgt aca tta Ala Lys Leu Lys Leu Tyr Glu Gln Met Ile Ser Asn Ala Arg Thr Leu 165 170 175 | 584 |
| tca gaa caa gga atg ttt gta tct gcg gaa aca atg ctc aat caa agt Ser Glu Gln Gly Met Phe Val Ser Ala Glu Thr Met Leu Asn Gln Ser 180 185 190 195 | 632 |
| acg cta cca cat tta cga aaa ata cat caa gaa gtc gtt cat gat atg Thr Leu Pro His Leu Arg Lys Ile His Gln Glu Val Val His Asp Met 200 205 210 | 680 |
| aaa tgt agc aga cac gag att cac cct atg tat cca gct gac ttt gca Lys Cys Ser Arg His Glu Ile His Pro Met Tyr Pro Ala Asp Phe Ala 215 220 225 | 728 |
| agt caa tta aat gtg tta act cta gcg gaa atg aaa aag aca att cat Ser Gln Leu Asn Val Leu Thr Leu Ala Glu Met Lys Lys Thr Ile His 230 235 240 | 776 |
| gat ata ttg gat ttc aga gat gaa gat att tgg atg tta ttt ggt act Asp Ile Leu Asp Phe Arg Asp Glu Asp Ile Trp Met Leu Phe Gly Thr 245 250 255 | 824 |
| ttg cct gtg ttt cca tgc tta aag gat gat gaa gat caa aag tta cta Leu Pro Val Phe Pro Cys Leu Lys Asp Asp Glu Asp Gln Lys Leu Leu 260 265 270 275 | 872 |
| tca cgt tta aga aat gct aac aat gta acg act aga aat gac ccg gat Ser Arg Leu Arg Asn Ala Asn Asn Val Thr Thr Arg Asn Asp Pro Asp 280 285 290 | 920 |
| ggc cgt agt cgt tta aat gtc aat gta ttt aca ggt aat gta atc gta Gly Arg Ser Arg Leu Asn Val Asn Val Phe Thr Gly Asn Val Ile Val 295 300 305 | 968 |
| act gat ttc gga gat gaa aca ggt aca att tcg aat ata caa aaa gat Thr Asp Phe Gly Asp Glu Thr Gly Thr Ile Ser Asn Ile Gln Lys Asp 310 315 320 | 1016 |
| aaa tta aca gat gta ttt gat aaa tgg tta tcc tct gat ctt gct aaa Lys Leu Thr Asp Val Phe Asp Lys Trp Leu Ser Ser Asp Leu Ala Lys 325 330 335 | 1064 |
| tca tta aat tgt cat tgt tcc gag ttt agt tgt tta gga cca aat gtt | 1112 |

Ser Leu Asn Cys His Cys Ser Glu Phe Ser Cys Leu Gly Pro Asn Val
 340 345 350 355

ctt gtt aaa aat atg tac tat ccg aat atg gat ttt aaa gat aat gag 1160
 Leu Val Lys Asn Met Tyr Tyr Pro Asn Met Asp Phe Lys Asp Asn Glu
 360 365 370

cgt cat atg cac aaa caa cca caa att ata caa ttt taaaaactct 1206
 Arg His Met His Lys Gln Pro Gln Ile Ile Gln Phe
 375 380

taattatgcg gag 1219

<210> 62
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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 62
 Met Asn Ser Val Lys Leu Lys Gln Pro Val Ser Ile Tyr Asn Asp Pro
 1 5 10 15

Trp Glu Ser Tyr Asn Asp Val Lys Glu His Gly Gln Leu Thr Leu Ser
 20 25 30

Asn Ile Glu Phe Thr Thr Thr Asn Leu Cys Asn Met Arg Cys Ser His
 35 40 45

Cys Ala Val Gly Tyr Thr Leu Gln Thr Val Asp Pro Glu Pro Leu Asp
 50 55 60

Met Asp Leu Ile Tyr Arg Arg Leu Asp Glu Ile Pro Asn Leu Arg Thr
 65 70 75 80

Met Ser Ile Thr Gly Gly Glu Pro Met Phe Ser Lys Lys Ser Ile Arg
 85 90 95

Asn Val Val Lys Pro Leu Leu Lys Tyr Ala His His Arg Gly Ile Tyr
 100 105 110

Thr Gln Met Asn Ser Asn Leu Thr Leu Pro Gln Asp Arg Tyr Leu Asp
 115 120 125

Ile Ala Glu Tyr Ile Asp Val Met His Ile Ser His Asn Trp Gly Thr
 130 135 140

Thr Asp Glu Phe Ala Asn Val Gly Phe Gly Ala Met Lys Lys Gln Pro
 145 150 155 160

Pro Leu Lys Ala Lys Leu Lys Leu Tyr Glu Gln Met Ile Ser Asn Ala
 165 170 175

Arg Thr Leu Ser Glu Gln Gly Met Phe Val Ser Ala Glu Thr Met Leu
 180 185 190

Asn Gln Ser Thr Leu Pro His Leu Arg Lys Ile His Gln Glu Val Val

| 195 | | | | | 200 | | | | | 205 | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| His | Asp | Met | Lys | Cys | Ser | Arg | His | Glu | Ile | His | Pro | Met | Tyr | Pro | Ala |
| 210 | | | | | | 215 | | | | | 220 | | | | |
| Asp | Phe | Ala | Ser | Gln | Leu | Asn | Val | Leu | Thr | Leu | Ala | Glu | Met | Lys | Lys |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |
| Thr | Ile | His | Asp | Ile | Leu | Asp | Phe | Arg | Asp | Glu | Asp | Ile | Trp | Met | Leu |
| | | | | 245 | | | | | 250 | | | | | 255 | |
| Phe | Gly | Thr | Leu | Pro | Val | Phe | Pro | Cys | Leu | Lys | Asp | Asp | Glu | Asp | Gln |
| | | | 260 | | | | | 265 | | | | | 270 | | |
| Lys | Leu | Leu | Ser | Arg | Leu | Arg | Asn | Ala | Asn | Asn | Val | Thr | Thr | Arg | Asn |
| | 275 | | | | | | 280 | | | | | 285 | | | |
| Asp | Pro | Asp | Gly | Arg | Ser | Arg | Leu | Asn | Val | Asn | Val | Phe | Thr | Gly | Asn |
| | 290 | | | | | 295 | | | | | 300 | | | | |
| Val | Ile | Val | Thr | Asp | Phe | Gly | Asp | Glu | Thr | Gly | Thr | Ile | Ser | Asn | Ile |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 |
| Gln | Lys | Asp | Lys | Leu | Thr | Asp | Val | Phe | Asp | Lys | Trp | Leu | Ser | Ser | Asp |
| | | | | 325 | | | | | 330 | | | | | 335 | |
| Leu | Ala | Lys | Ser | Leu | Asn | Cys | His | Cys | Ser | Glu | Phe | Ser | Cys | Leu | Gly |
| | | | 340 | | | | | 345 | | | | | 350 | | |
| Pro | Asn | Val | Leu | Val | Lys | Asn | Met | Tyr | Tyr | Pro | Asn | Met | Asp | Phe | Lys |
| | 355 | | | | | | 360 | | | | | 365 | | | |
| Asp | Asn | Glu | Arg | His | Met | His | Lys | Gln | Pro | Gln | Ile | Ile | Gln | Phe | |
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 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(595)
 <223> RXN00833

<400> 63
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 tttctagcac caaaacaaaa ctctccctag tatgggggtcc atg gct aaa aca cat 115
 Met Ala Lys Thr His
 1 5
 ttt caa ggc aac gaa act gct acc tcc ggc gaa ctg cca cag gtc ggc 163
 Phe Gln Gly Asn Glu Thr Ala Thr Ser Gly Glu Leu Pro Gln Val Gly
 10 15 20

gac aac ctc gca gag ttc aac ctc gtc aac acc gaa ctg ggc gag gtc 211
 Asp Asn Leu Ala Glu Phe Asn Leu Val Asn Thr Glu Leu Gly Glu Val
 25 30 35

tcc tca aag gac ttc cag ggc cgc aag ctt gtc ctg aac atc ttc cca 259
 Ser Ser Lys Asp Phe Gln Gly Arg Lys Leu Val Leu Asn Ile Phe Pro
 40 45 50

tcc gtt gac acc ggc gtt tgt gca aca tca gtc cgc aag ttc aac gag 307
 Ser Val Asp Thr Gly Val Cys Ala Thr Ser Val Arg Lys Phe Asn Glu
 55 60 65

gca gca gca agc ctg gaa aac acc acc gtg ctg tgc atc tcc aag gat 355
 Ala Ala Ala Ser Leu Glu Asn Thr Thr Val Leu Cys Ile Ser Lys Asp
 70 75 80 85

ctt cca ttc gca ctg ggc cgt ttc tgc tcc gca gaa ggc atc gag aac 403
 Leu Pro Phe Ala Leu Gly Arg Phe Cys Ser Ala Glu Gly Ile Glu Asn
 90 95 100

gtc acc cca gta tcc gca ttc cgt tcc acc ttc ggt gaa gac aac ggc 451
 Val Thr Pro Val Ser Ala Phe Arg Ser Thr Phe Gly Glu Asp Asn Gly
 105 110 115

atc gtg ctc gaa ggc tca cca ctt aag ggt ctt ctt gca cgc agc gtc 499
 Ile Val Leu Glu Gly Ser Pro Leu Lys Gly Leu Leu Ala Arg Ser Val
 120 125 130

atc gtc gtc gat gaa aac ggc aag gtt gct tac acc cag ttg gtt gat 547
 Ile Val Val Asp Glu Asn Gly Lys Val Ala Tyr Thr Gln Leu Val Asp
 135 140 145

gag atc ttc act gaa cct gat tac gac gct gca ctt gct ggg ctg aac 595
 Glu Ile Phe Thr Glu Pro Asp Tyr Asp Ala Ala Leu Ala Gly Leu Asn
 150 155 160 165

taatttactt cgctcagggg aat 618

<210> 64
 <211> 165
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 64
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Leu Pro Gln Val Gly Asp Asn Leu Ala Glu Phe Asn Leu Val Asn Thr
 20 25 30

Glu Leu Gly Glu Val Ser Ser Lys Asp Phe Gln Gly Arg Lys Leu Val
 35 40 45

Leu Asn Ile Phe Pro Ser Val Asp Thr Gly Val Cys Ala Thr Ser Val
 50 55 60

Arg Lys Phe Asn Glu Ala Ala Ala Ser Leu Glu Asn Thr Thr Val Leu
 65 70 75 80

Cys Ile Ser Lys Asp Leu Pro Phe Ala Leu Gly Arg Phe Cys Ser Ala
 85 90 95

Glu Gly Ile Glu Asn Val Thr Pro Val Ser Ala Phe Arg Ser Thr Phe
 100 105 110

Gly Glu Asp Asn Gly Ile Val Leu Glu Gly Ser Pro Leu Lys Gly Leu
 115 120 125

Leu Ala Arg Ser Val Ile Val Val Asp Glu Asn Gly Lys Val Ala Tyr
 130 135 140

Thr Gln Leu Val Asp Glu Ile Phe Thr Glu Pro Asp Tyr Asp Ala Ala
 145 150 155 160

Leu Ala Gly Leu Asn
 165

<210> 65
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 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(856)
 <223> RXN01676

<400> 65
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accagcattt tttgcatcct cagtgggtgc tggcccgcgc atg atc ctt cac ggt 115
 Met Ile Leu His Gly
 1 5

gtt gtg ttc tac gca gga ctt cta gta ctt ctc gtg cca ctt ggc ctt 163
 Val Val Phe Tyr Ala Gly Leu Leu Val Leu Leu Val Pro Leu Gly Leu
 10 15 20

ggt gcg gga atc ctc ggc gag ctg ttt atc acc caa cgc cag acc atc 211
 Gly Ala Gly Ile Leu Gly Glu Leu Phe Ile Thr Gln Arg Gln Thr Ile
 25 30 35

atc gtg gtt tca tcg atc gtg ctg att atc cta ggt ttt gtc cag atc 259
 Ile Val Val Ser Ser Ile Val Leu Ile Ile Leu Gly Phe Val Gln Ile
 40 45 50

ttc ggc ggc gga ttc gac ttc gga aaa gca ctc cca gga tta gat cgt 307
 Phe Gly Gly Gly Phe Asp Phe Gly Lys Ala Leu Pro Gly Leu Asp Arg
 55 60 65

ctg caa tct aag gcc act gtg acc tca ggt cta gga aag agc ttt tta 355
 Leu Gln Ser Lys Ala Thr Val Thr Ser Gly Leu Gly Lys Ser Phe Leu

| 70 | 75 | 80 | 85 | |
|---|-----|-----|-----|-----|
| cta gga atg acc agt agt att gcc ggt ttt tgt tcc gga cca atc ctc | | | | 403 |
| Leu Gly Met Thr Ser Ser Ile Ala Gly Phe Cys Ser Gly Pro Ile Leu | 90 | 95 | 100 | |
| ggc gcc gtt ctt act ttg gct gcc acc agt gga aac tcc atc acc tca | | | | 451 |
| Gly Ala Val Leu Thr Leu Ala Ala Thr Ser Gly Asn Ser Ile Thr Ser | 105 | 110 | 115 | |
| gca ctc att ttg agt gct tat ggt gcg gga atg gtg ctg ccc ctg atg | | | | 499 |
| Ala Leu Ile Leu Ser Ala Tyr Gly Ala Gly Met Val Leu Pro Leu Met | 120 | 125 | 130 | |
| gct att gca gcg ctc tgg gcc aaa ctc gga cag cgt gga cag cag atg | | | | 547 |
| Ala Ile Ala Ala Leu Trp Ala Lys Leu Gly Gln Arg Gly Gln Gln Met | 135 | 140 | 145 | |
| ctc cgc ggc cgg gaa ttc acc ttc ttg ggc agg cag tgg cac att gtt | | | | 595 |
| Leu Arg Gly Arg Glu Phe Thr Phe Leu Gly Arg Gln Trp His Ile Val | 150 | 155 | 160 | 165 |
| tct gtc att agc ggt gcc ctg atc atc gct gtc gga atc ctc ttt tgg | | | | 643 |
| Ser Val Ile Ser Gly Ala Leu Ile Ile Ala Val Gly Ile Leu Phe Trp | 170 | 175 | 180 | |
| tcc acg aac ggc ctt gtc agc atg ccg gag ctc gtt cca atg gac acc | | | | 691 |
| Ser Thr Asn Gly Leu Val Ser Met Pro Glu Leu Val Pro Met Asp Thr | 185 | 190 | 195 | |
| cag atc tgg cta cag gaa gcc aca ttc tca ctc ggg tca cca ctc ttt | | | | 739 |
| Gln Ile Trp Leu Gln Glu Ala Thr Phe Ser Leu Gly Ser Pro Leu Phe | 200 | 205 | 210 | |
| gac atc gca ttg atc att gtc gcc gct ggc ttg ttc ttg tac ttc tgg | | | | 787 |
| Asp Ile Ala Leu Ile Ile Val Ala Ala Gly Leu Phe Leu Tyr Phe Trp | 215 | 220 | 225 | |
| aac aaa cga caa aag cga aaa gaa gaa gct cag cga ccc aaa gaa agt | | | | 835 |
| Asn Lys Arg Gln Lys Arg Lys Glu Glu Ala Gln Arg Pro Lys Glu Ser | 230 | 235 | 240 | 245 |
| gga tgg gtt att aac cct cgc taattattag ttttggagcg agg | | | | 879 |
| Gly Trp Val Ile Asn Pro Arg | 250 | | | |

<210> 66

<211> 252

<212> PRT

<213> Corynebacterium glutamicum

<400> 66

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Ile | Leu | His | Gly | Val | Val | Phe | Tyr | Ala | Gly | Leu | Leu | Val | Leu | Leu |
| 1 | | | | | 5 | | | | 10 | | | | | 15 | |

Val Pro Leu Gly Leu Gly Ala Gly Ile Leu Gly Glu Leu Phe Ile Thr

| 20 | | | | | 25 | | | | | 30 | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Gln | Arg | Gln | Thr | Ile | Ile | Val | Val | Ser | Ser | Ile | Val | Leu | Ile | Ile | Leu |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Gly | Phe | Val | Gln | Ile | Phe | Gly | Gly | Gly | Phe | Asp | Phe | Gly | Lys | Ala | Leu |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Pro | Gly | Leu | Asp | Arg | Leu | Gln | Ser | Lys | Ala | Thr | Val | Thr | Ser | Gly | Leu |
| | 65 | | | | | 70 | | | | | 75 | | | | 80 |
| Gly | Lys | Ser | Phe | Leu | Leu | Gly | Met | Thr | Ser | Ser | Ile | Ala | Gly | Phe | Cys |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Ser | Gly | Pro | Ile | Leu | Gly | Ala | Val | Leu | Thr | Leu | Ala | Ala | Thr | Ser | Gly |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Asn | Ser | Ile | Thr | Ser | Ala | Leu | Ile | Leu | Ser | Ala | Tyr | Gly | Ala | Gly | Met |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Val | Leu | Pro | Leu | Met | Ala | Ile | Ala | Ala | Leu | Trp | Ala | Lys | Leu | Gly | Gln |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Arg | Gly | Gln | Gln | Met | Leu | Arg | Gly | Arg | Glu | Phe | Thr | Phe | Leu | Gly | Arg |
| | 145 | | | | | 150 | | | | | 155 | | | | 160 |
| Gln | Trp | His | Ile | Val | Ser | Val | Ile | Ser | Gly | Ala | Leu | Ile | Ile | Ala | Val |
| | | | 165 | | | | | | 170 | | | | | 175 | |
| Gly | Ile | Leu | Phe | Trp | Ser | Thr | Asn | Gly | Leu | Val | Ser | Met | Pro | Glu | Leu |
| | | | 180 | | | | | 185 | | | | | 190 | | |
| Val | Pro | Met | Asp | Thr | Gln | Ile | Trp | Leu | Gln | Glu | Ala | Thr | Phe | Ser | Leu |
| | | 195 | | | | | 200 | | | | | 205 | | | |
| Gly | Ser | Pro | Leu | Phe | Asp | Ile | Ala | Leu | Ile | Ile | Val | Ala | Ala | Gly | Leu |
| | | 210 | | | | 215 | | | | | 220 | | | | |
| Phe | Leu | Tyr | Phe | Trp | Asn | Lys | Arg | Gln | Lys | Arg | Lys | Glu | Glu | Ala | Gln |
| | 225 | | | | | 230 | | | | | 235 | | | | 240 |
| Arg | Pro | Lys | Glu | Ser | Gly | Trp | Val | Ile | Asn | Pro | Arg | | | | |
| | | | 245 | | | | | | 250 | | | | | | |

<210> 67
 <211> 744
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(721)
 <223> RXN00380

<400> 67
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| | | | | | | | | | | | | | | | | |
|------|--------|-------|-------|--------|-----|-------|-------|-----|-----|-----|---------|------------|-----|-----|-----|-----|
| cgtg | cattac | aacga | accag | ctcagg | gat | ttgat | cactc | | gtg | cgt | ttg | acc | aaa | | 115 | |
| | | | | | | | | | Val | Arg | Leu | Thr | Lys | | | |
| | | | | | | | | | 1 | | | | 5 | | | |
| cta | gca | gca | aca | atc | ggc | tgc | gtg | aca | ctc | agc | gga | ctt | gcg | cta | gta | 163 |
| Leu | Ala | Ala | Thr | Ile | Gly | Cys | Val | Thr | Leu | Ser | Gly | Leu | Ala | Leu | Val | |
| | | | | 10 | | | | | 15 | | | | | 20 | | |
| gcc | tgc | agc | agt | gac | agt | acc | gct | ggg | act | gac | gct | gtt | gct | gtc | ggc | 211 |
| Ala | Cys | Ser | Ser | Asp | Ser | Thr | Ala | Gly | Thr | Asp | Ala | Val | Ala | Val | Gly | |
| | | | 25 | | | | | 30 | | | | | 35 | | | |
| gga | acc | ttc | caa | ttc | cac | tcc | ccg | gat | gga | aag | atg | gaa | att | ttc | tac | 259 |
| Gly | Thr | Phe | Gln | Phe | His | Ser | Pro | Asp | Gly | Lys | Met | Glu | Ile | Phe | Tyr | |
| | | 40 | | | | | 45 | | | | | 50 | | | | |
| gac | gag | gct | gac | cgt | caa | caa | ctc | ccc | gac | att | ggg | gga | gat | tcc | ctc | 307 |
| Asp | Glu | Ala | Asp | Arg | Gln | Gln | Leu | Pro | Asp | Ile | Gly | Gly | Asp | Ser | Leu | |
| | 55 | | | | | 60 | | | | | 65 | | | | | |
| atg | gaa | gag | ggc | aca | cag | atc | aac | ctg | tct | gat | ttc | gaa | aac | caa | gtt | 355 |
| Met | Glu | Glu | Gly | Thr | Gln | Ile | Asn | Leu | Ser | Asp | Phe | Glu | Asn | Gln | Val | |
| | 70 | | | | 75 | | | | | 80 | | | | | 85 | |
| gtc | atc | ctc | aat | gcg | tgg | ggg | cag | tgg | tgt | gca | ccg | tgc | cgc | tcc | gaa | 403 |
| Val | Ile | Leu | Asn | Ala | Trp | Gly | Gln | Trp | Cys | Ala | Pro | Cys | Arg | Ser | Glu | |
| | | | | 90 | | | | | 95 | | | | | 100 | | |
| tcc | gat | gat | ctc | cag | att | atc | cat | gag | gaa | ctc | caa | gct | gcc | gga | aac | 451 |
| Ser | Asp | Asp | Leu | Gln | Ile | Ile | His | Glu | Glu | Leu | Gln | Ala | Ala | Gly | Asn | |
| | | | 105 | | | | | 110 | | | | | 115 | | | |
| ggc | gac | acc | cct | ggg | ggc | acc | gtg | ttg | ggg | atc | aat | gtg | cgt | gat | tac | 499 |
| Gly | Asp | Thr | Pro | Gly | Gly | Thr | Val | Leu | Gly | Ile | Asn | Val | Arg | Asp | Tyr | |
| | | 120 | | | | | 125 | | | | | 130 | | | | |
| tcc | cgc | gac | atc | gcc | caa | gac | ttt | gtc | acc | gac | aac | ggc | ctt | gat | tac | 547 |
| Ser | Arg | Asp | Ile | Ala | Gln | Asp | Phe | Val | Thr | Asp | Asn | Gly | Leu | Asp | Tyr | |
| | 135 | | | | | 140 | | | | | 145 | | | | | |
| cca | agc | att | tac | gat | cca | cca | ttt | atg | aca | gca | gca | tcc | ctc | ggg | ggg | 595 |
| Pro | Ser | Ile | Tyr | Asp | Pro | Pro | Phe | Met | Thr | Ala | Ala | Ser | Leu | Gly | Gly | |
| | | | | | 155 | | | | | 160 | | | | | 165 | |
| gtt | ccc | gca | tcg | gtg | atc | cca | acc | acc | atc | gtg | ctg | gat | aaa | cag | cac | 643 |
| Val | Pro | Ala | Ser | Val | Ile | Pro | Thr | Thr | Ile | Val | Leu | Asp | Lys | Gln | His | |
| | | | | 170 | | | | | 175 | | | | | 180 | | |
| cgc | ccc | gca | gca | gtg | ttc | ttg | cgc | gaa | gtc | acc | tcc | aaa | gat | gtg | ttg | 691 |
| Arg | Pro | Ala | Ala | Val | Phe | Leu | Arg | Glu | Val | Thr | Ser | Lys | Asp | Val | Leu | |
| | | | 185 | | | | | 190 | | | | | 195 | | | |
| gat | gtt | gcg | ttg | cca | ttg | gta | gat | gag | gcc | taa | atgtctg | agattgtggt | | | | 741 |
| Asp | Val | | | | | | | | | | | | | | | |

agc

744

<210> 68
<211> 207
<212> PRT
<213> Corynebacterium glutamicum

<400> 68
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20 25 30
Ala Val Ala Val Gly Gly Thr Phe Gln Phe His Ser Pro Asp Gly Lys
35 40 45
Met Glu Ile Phe Tyr Asp Glu Ala Asp Arg Gln Gln Leu Pro Asp Ile
50 55 60
Gly Gly Asp Ser Leu Met Glu Glu Gly Thr Gln Ile Asn Leu Ser Asp
65 70 75 80
Phe Glu Asn Gln Val Val Ile Leu Asn Ala Trp Gly Gln Trp Cys Ala
85 90 95
Pro Cys Arg Ser Glu Ser Asp Asp Leu Gln Ile Ile His Glu Glu Leu
100 105 110
Gln Ala Ala Gly Asn Gly Asp Thr Pro Gly Gly Thr Val Leu Gly Ile
115 120 125
Asn Val Arg Asp Tyr Ser Arg Asp Ile Ala Gln Asp Phe Val Thr Asp
130 135 140
Asn Gly Leu Asp Tyr Pro Ser Ile Tyr Asp Pro Pro Phe Met Thr Ala
145 150 155 160
Ala Ser Leu Gly Gly Val Pro Ala Ser Val Ile Pro Thr Thr Ile Val
165 170 175
Leu Asp Lys Gln His Arg Pro Ala Ala Val Phe Leu Arg Glu Val Thr
180 185 190
Ser Lys Asp Val Leu Asp Val Ala Leu Pro Leu Val Asp Glu Ala
195 200 205

<210> 69
<211> 495
<212> DNA
<213> Corynebacterium glutamicum

<220>
<221> CDS
<222> (101)..(472)

<223> RXN00937

<400> 69

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 Met Ala Thr Ile Asp
 1 5

gta acc gaa gaa aca ttt gag agc aca gtt acc ggc gac gga att gtc 163
 Val Thr Glu Glu Thr Phe Glu Ser Thr Val Thr Gly Asp Gly Ile Val
 10 15 20

ctc gta gac gca tgg gca tcc tgg tgc gga cct tgc cgc cag ttc gcc 211
 Leu Val Asp Ala Trp Ala Ser Trp Cys Gly Pro Cys Arg Gln Phe Ala
 25 30 35

cca acc tac gag aag gtt tcc gaa acc cac acc gac gca acc ttc gcc 259
 Pro Thr Tyr Glu Lys Val Ser Glu Thr His Thr Asp Ala Thr Phe Ala
 40 45 50

aag ctt gat acc gaa gca aac cag ggc ctg gct gca gca ctg cag atc 307
 Lys Leu Asp Thr Glu Ala Asn Gln Gly Leu Ala Ala Ala Leu Gln Ile
 55 60 65

cag tcc atc cca act ctg atg gtt ttc cgc gac ggc atc atg gtc tac 355
 Gln Ser Ile Pro Thr Leu Met Val Phe Arg Asp Gly Ile Met Val Tyr
 70 75 80 85

cgc gaa gcc ggc acc atg cca gct cct gca ctg gat gat ctg gtc aac 403
 Arg Glu Ala Gly Thr Met Pro Ala Pro Ala Leu Asp Asp Leu Val Asn
 90 95 100

cag gtt aag gca ctc gac atg gat gac gtt cgt cgc cag gtc gca gag 451
 Gln Val Lys Ala Leu Asp Met Asp Asp Val Arg Arg Gln Val Ala Glu
 105 110 115

cag cag ggt tct gca gag gca taagcttcca attgtgtttt ggt 495
 Gln Gln Gly Ser Ala Glu Ala
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<210> 70

<211> 124

<212> PRT

<213> Corynebacterium glutamicum

<400> 70

Met Ala Thr Ile Asp Val Thr Glu Glu Thr Phe Glu Ser Thr Val Thr
 1 5 10 15

Gly Asp Gly Ile Val Leu Val Asp Ala Trp Ala Ser Trp Cys Gly Pro
 20 25 30

Cys Arg Gln Phe Ala Pro Thr Tyr Glu Lys Val Ser Glu Thr His Thr
 35 40 45

Asp Ala Thr Phe Ala Lys Leu Asp Thr Glu Ala Asn Gln Gly Leu Ala
50 55 60

Ala Ala Leu Gln Ile Gln Ser Ile Pro Thr Leu Met Val Phe Arg Asp
65 70 75 80

Gly Ile Met Val Tyr Arg Glu Ala Gly Thr Met Pro Ala Pro Ala Leu
85 90 95

Asp Asp Leu Val Asn Gln Val Lys Ala Leu Asp Met Asp Asp Val Arg
100 105 110

Arg Gln Val Ala Glu Gln Gln Gly Ser Ala Glu Ala
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<210> 71

<211> 990

<212> DNA

<213> Corynebacterium glutamicum

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<222> (101)..(967)

<223> RXN02325

<400> 71

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tgcacccgtc taatgaaaat cattactatt aggtgtcatg atg gac cat gca cac 115
Met Asp His Ala His
1 5

gat tcc tgc tca cca act ctg cgc cgt gat ttg gag gtc act ggc cag 163
Asp Ser Cys Ser Pro Thr Leu Arg Arg Asp Leu Glu Val Thr Gly Gln
10 15 20

ctc caa cct gag aaa gct gtc gat tta gca gcg ccg cac gaa ggg aag 211
Leu Gln Pro Glu Lys Ala Val Asp Leu Ala Ala Pro His Glu Gly Lys
25 30 35

gtt gcc aat ata acg aag gtg acc tcc tca aat atg gag cac acc atc 259
Val Ala Asn Ile Thr Lys Val Thr Ser Ser Asn Met Glu His Thr Ile
40 45 50

acg cag gcc tca aaa gct aag gag gtg gtg gtg ctc att ggt cac tcc 307
Thr Gln Ala Ser Lys Ala Lys Glu Val Val Val Leu Ile Gly His Ser
55 60 65

ctg ctg ccc aca ttt cag gat ttg gaa aaa gac att ctg cac ttt cag 355
Leu Leu Pro Thr Phe Gln Asp Leu Glu Lys Asp Ile Leu His Phe Gln
70 75 80 85

gca ggt aat aaa ggg cga ttt tct gta gcg att gtt gat cct gat cgc 403
Ala Gly Asn Lys Gly Arg Phe Ser Val Ala Ile Val Asp Pro Asp Arg
90 95 100

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agt gca gat gtg gtt gcc aga ttt agg cca aaa cag att ccg gtg gca 451
Ser Ala Asp Val Val Ala Arg Phe Arg Pro Lys Gln Ile Pro Val Ala
      105                      110                      115

tac gtg gtg aaa gat ggc gcc agc att gcg gag ttc aac tcg ctc aac 499
Tyr Val Val Lys Asp Gly Ala Ser Ile Ala Glu Phe Asn Ser Leu Asn
      120                      125                      130

aag gag ccg gtt gca caa tgg ctt gat cat ttt gtg tcg cgg gaa acg 547
Lys Glu Pro Val Ala Gln Trp Leu Asp His Phe Val Ser Arg Glu Thr
      135                      140                      145

atc ccc aat gaa aaa gag ggg gac gtc gat aag caa ata gac ccg cgc 595
Ile Pro Asn Glu Lys Glu Gly Asp Val Asp Lys Gln Ile Asp Pro Arg
      150                      155                      160                      165

ctg tgg cgg gca gcg gaa ttg gtg aac gcc ggt gat ttt cgc gcg gcg 643
Leu Trp Arg Ala Ala Glu Leu Val Asn Ala Gly Asp Phe Arg Ala Ala
      170                      175                      180

ttg gcg ttg tat gag cag ttg ccg cag gat gcg acg gtg aag cgg gcg 691
Leu Ala Leu Tyr Glu Gln Leu Pro Gln Asp Ala Thr Val Lys Arg Ala
      185                      190                      195

cac gcg gcg gtg tcg gta ttg gcg cgg atg tct gtg gcg gat cgg gga 739
His Ala Ala Val Ser Val Leu Ala Arg Met Ser Val Ala Asp Arg Gly
      200                      205                      210

gag gat ccg atc gag aag tcg cgc cgg gat cca gac gat gtg aac aag 787
Glu Asp Pro Ile Glu Lys Ser Arg Arg Asp Pro Asp Asp Val Asn Lys
      215                      220                      225

gcg ctg gcg gcg gcg gat atg tat gtg ttg atg aat cag ccg gac aca 835
Ala Leu Ala Ala Ala Asp Met Tyr Val Leu Met Asn Gln Pro Asp Thr
      230                      235                      240                      245

gcg ctc gcg cac ctt gca gca cta ttg cca aaa ccg gag gct gcc cgg 883
Ala Leu Ala His Leu Ala Ala Leu Leu Pro Lys Pro Glu Ala Ala Arg
      250                      255                      260

cgg atc gtg gag ttg ctg aac ttg ttt gat ccg ctg gac ctg gtc gca 931
Arg Ile Val Glu Leu Leu Asn Leu Phe Asp Pro Leu Asp Leu Val Ala
      265                      270                      275

ttg gaa atc agg gcg cag gtg ggg aat gca atg agc taagaaaaca 977
Leu Glu Ile Arg Ala Gln Val Gly Asn Ala Met Ser
      280                      285

ctttaaatat tct 990

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<210> 72

<211> 289

<212> PRT

<213> Corynebacterium glutamicum

<400> 72

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 20 25 30
 Pro His Glu Gly Lys Val Ala Asn Ile Thr Lys Val Thr Ser Ser Asn
 35 40 45
 Met Glu His Thr Ile Thr Gln Ala Ser Lys Ala Lys Glu Val Val Val
 50 55 60
 Leu Ile Gly His Ser Leu Leu Pro Thr Phe Gln Asp Leu Glu Lys Asp
 65 70 75 80
 Ile Leu His Phe Gln Ala Gly Asn Lys Gly Arg Phe Ser Val Ala Ile
 85 90 95
 Val Asp Pro Asp Arg Ser Ala Asp Val Val Ala Arg Phe Arg Pro Lys
 100 105 110
 Gln Ile Pro Val Ala Tyr Val Val Lys Asp Gly Ala Ser Ile Ala Glu
 115 120 125
 Phe Asn Ser Leu Asn Lys Glu Pro Val Ala Gln Trp Leu Asp His Phe
 130 135 140
 Val Ser Arg Glu Thr Ile Pro Asn Glu Lys Glu Gly Asp Val Asp Lys
 145 150 155 160
 Gln Ile Asp Pro Arg Leu Trp Arg Ala Ala Glu Leu Val Asn Ala Gly
 165 170 175
 Asp Phe Arg Ala Ala Leu Ala Leu Tyr Glu Gln Leu Pro Gln Asp Ala
 180 185 190
 Thr Val Lys Arg Ala His Ala Ala Val Ser Val Leu Ala Arg Met Ser
 195 200 205
 Val Ala Asp Arg Gly Glu Asp Pro Ile Glu Lys Ser Arg Arg Asp Pro
 210 215 220
 Asp Asp Val Asn Lys Ala Leu Ala Ala Ala Asp Met Tyr Val Leu Met
 225 230 235 240
 Asn Gln Pro Asp Thr Ala Leu Ala His Leu Ala Ala Leu Leu Pro Lys
 245 250 255
 Pro Glu Ala Ala Arg Arg Ile Val Glu Leu Leu Asn Leu Phe Asp Pro
 260 265 270
 Leu Asp Leu Val Ala Leu Glu Ile Arg Ala Gln Val Gly Asn Ala Met
 275 280 285
 Ser

<210> 73
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 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(877)
 <223> RXN01837

<400> 73

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ttggacattc tcaaaatcaa gtagcaaggg atcaaactct gtg agt act aat aag 115
                               Val Ser Thr Asn Lys
                               1 5

gaa cga cgc caa cag gcg ctt tcc cag ctg gag aaa gaa atc aaa agc 163
Glu Arg Arg Gln Gln Ala Leu Ser Gln Leu Glu Lys Glu Ile Lys Ser
                10                15                20

cgg gac cgc aaa gaa aag acc aag cca cta acc gtg gtc ttt gct tcc 211
Arg Asp Arg Lys Glu Lys Thr Lys Pro Leu Thr Val Val Phe Ala Ser
                25                30                35

ctg gct gtc atc ctg gtt gtc gtt ggc ggt atc tgg tac gca gct acc 259
Leu Ala Val Ile Leu Val Val Val Gly Gly Ile Trp Tyr Ala Ala Thr
                40                45                50

cgc agc acc gaa gac gaa gtc atc acc gct gat gaa aca tcc acc acc 307
Arg Ser Thr Glu Asp Glu Val Ile Thr Ala Asp Glu Thr Ser Thr Thr
                55                60                65

gca gag acc cct gac tac cag cca ctg gcg ctg acc cgc acc acc gcg 355
Ala Glu Thr Pro Asp Tyr Gln Pro Leu Ala Leu Thr Arg Thr Thr Ala
                70                75                80                85

ctc ggc gac tcc gtg acc tgt gag tac cca gat gct ggc gag gct tcc 403
Leu Gly Asp Ser Val Thr Cys Glu Tyr Pro Asp Ala Gly Glu Ala Ser
                90                95                100

aag gat gtc tcc aag cct gct act gaa aac gtg cca gca acc ggc acc 451
Lys Asp Val Ser Lys Pro Ala Thr Glu Asn Val Pro Ala Thr Gly Thr
                105                110                115

gtg acc gtc aac ctg acc acc gcc cag ggc aac atc ggc atg gaa ctt 499
Val Thr Val Asn Leu Thr Thr Ala Gln Gly Asn Ile Gly Met Glu Leu
                120                125                130

gat cgc tcc gta tcc cct tgt acc gtc aac gct gtt gag cac atg gct 547
Asp Arg Ser Val Ser Pro Cys Thr Val Asn Ala Val Glu His Met Ala
                135                140                145

tcc gag ggc tac tac aac gat act gtc tgc cac cgc atc acc acc tct 595
Ser Glu Gly Tyr Tyr Asn Asp Thr Val Cys His Arg Ile Thr Thr Ser
150                155                160                165

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ggc att tac gtt ctc cag tgc ggc gat cca agc agc acc ggc gca ggc 643
 Gly Ile Tyr Val Leu Gln Cys Gly Asp Pro Ser Ser Thr Gly Ala Gly
 170 175 180

ggc cca ggg ttc agc ttc gcc aac gaa tac cca acc gac gaa gca act 691
 Gly Pro Gly Phe Ser Phe Ala Asn Glu Tyr Pro Thr Asp Glu Ala Thr
 185 190 195

gac cta acc acc cca gtc atc tac gag cgc ggc acc atc gcc atg gcc 739
 Asp Leu Thr Thr Pro Val Ile Tyr Glu Arg Gly Thr Ile Ala Met Ala
 200 205 210

aac gct ggc gct gac acc aac ggg ctc cca gtt ctt cct caa cta cga 787
 Asn Ala Gly Ala Asp Thr Asn Gly Leu Pro Val Leu Pro Gln Leu Arg
 215 220 225

gga ttc ccc act ggc acc gaa cta cac cta ctt cgg cca gat cac cga 835
 Gly Phe Pro Thr Gly Thr Glu Leu His Leu Leu Arg Pro Asp His Arg
 230 235 240 245

aga agg cct tgc aac cct cga cgc cat cgc aga agt tgg cac 877
 Arg Arg Pro Cys Asn Pro Arg Arg His Arg Arg Ser Trp His
 250 255

tgaaggtgga accggcgacg gag 900

<210> 74
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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 74
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 1 5 10 15

Lys Glu Ile Lys Ser Arg Asp Arg Lys Glu Lys Thr Lys Pro Leu Thr
 20 25 30

Val Val Phe Ala Ser Leu Ala Val Ile Leu Val Val Val Gly Gly Ile
 35 40 45

Trp Tyr Ala Ala Thr Arg Ser Thr Glu Asp Glu Val Ile Thr Ala Asp
 50 55 60

Glu Thr Ser Thr Thr Ala Glu Thr Pro Asp Tyr Gln Pro Leu Ala Leu
 65 70 75 80

Thr Arg Thr Thr Ala Leu Gly Asp Ser Val Thr Cys Glu Tyr Pro Asp
 85 90 95

Ala Gly Glu Ala Ser Lys Asp Val Ser Lys Pro Ala Thr Glu Asn Val
 100 105 110

Pro Ala Thr Gly Thr Val Thr Val Asn Leu Thr Thr Ala Gln Gly Asn
 115 120 125

Ile Gly Met Glu Leu Asp Arg Ser Val Ser Pro Cys Thr Val Asn Ala
 130 135 140

Val Glu His Met Ala Ser Glu Gly Tyr Tyr Asn Asp Thr Val Cys His
 145 150 155 160

Arg Ile Thr Thr Ser Gly Ile Tyr Val Leu Gln Cys Gly Asp Pro Ser
 165 170 175

Ser Thr Gly Ala Gly Gly Pro Gly Phe Ser Phe Ala Asn Glu Tyr Pro
 180 185 190

Thr Asp Glu Ala Thr Asp Leu Thr Thr Pro Val Ile Tyr Glu Arg Gly
 195 200 205

Thr Ile Ala Met Ala Asn Ala Gly Ala Asp Thr Asn Gly Leu Pro Val
 210 215 220

Leu Pro Gln Leu Arg Gly Phe Pro Thr Gly Thr Glu Leu His Leu Leu
 225 230 235 240

Arg Pro Asp His Arg Arg Arg Pro Cys Asn Pro Arg Arg His Arg Arg
 245 250 255

Ser Trp His

<210> 75

<211> 741

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(741)

<223> RXN01926

<400> 75

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 1 5 10 15

gtc tgg aaa gcc gcc acc gaa gaa gca gaa ctc ctc gca gct gac ggc 96
 Val Trp Lys Ala Ala Thr Glu Glu Ala Glu Leu Leu Ala Ala Asp Gly
 20 25 30

gcc gtc cac gac cag gaa ctc ttc ctc aac tgc acc acc tcc cca ctg 144
 Ala Val His Asp Gln Glu Leu Phe Leu Asn Cys Thr Thr Ser Pro Leu
 35 40 45

atc ttc gcc tcc gcg atg ctc aac ttc ggc gtc cac caa atc ctg gac 192
 Ile Phe Ala Ser Ala Met Leu Asn Phe Gly Val His Gln Ile Leu Asp
 50 55 60

acc ctc tgc caa ctc gca cca tcc ccc gcc ggc cgc gac gca gac ccc 240

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Thr | Leu | Cys | Gln | Leu | Ala | Pro | Ser | Pro | Ala | Gly | Arg | Asp | Ala | Asp | Pro | |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 | |
| aaa | gcc | ctc | gaa | gcc | gcc | acc | tcc | gca | atg | gac | gac | cac | cgc | gac | acc | 288 |
| Lys | Ala | Leu | Glu | Ala | Ala | Thr | Ser | Ala | Met | Asp | Asp | His | Arg | Asp | Thr | |
| | | | 85 | | | | | | 90 | | | | | 95 | | |
| acc | gac | gac | ttc | tcc | ggc | gtc | gtc | ttc | aaa | gtc | caa | gcc | ggc | atg | gac | 336 |
| Thr | Asp | Asp | Phe | Ser | Gly | Val | Val | Phe | Lys | Val | Gln | Ala | Gly | Met | Asp | |
| | | | 100 | | | | | 105 | | | | | 110 | | | |
| aaa | aac | cac | cgc | gat | acc | ctc | gcc | ttc | atg | cgc | gtc | gtc | tcc | ggc | gaa | 384 |
| Lys | Asn | His | Arg | Asp | Thr | Leu | Ala | Phe | Met | Arg | Val | Val | Ser | Gly | Glu | |
| | | 115 | | | | | 120 | | | | | 125 | | | | |
| ttc | gac | cgc | ggc | atg | caa | gtc | acc | cac | tcc | caa | tcc | ggc | cgc | agc | ttc | 432 |
| Phe | Asp | Arg | Gly | Met | Gln | Val | Thr | His | Ser | Gln | Ser | Gly | Arg | Ser | Phe | |
| | 130 | | | | | 135 | | | | | 140 | | | | | |
| tcc | acc | aaa | tac | gcc | ctc | acc | gtc | ttc | ggc | cgc | acc | cgc | tct | acc | gtc | 480 |
| Ser | Thr | Lys | Tyr | Ala | Leu | Thr | Val | Phe | Gly | Arg | Thr | Arg | Ser | Thr | Val | |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 | |
| gaa | acc | gcc | ttc | ccc | ggc | gac | atc | gtc | ggc | ctc | gtc | aac | gcc | ggc | gcc | 528 |
| Glu | Thr | Ala | Phe | Pro | Gly | Asp | Ile | Val | Gly | Leu | Val | Asn | Ala | Gly | Ala | |
| | | | 165 | | | | | | 170 | | | | | 175 | | |
| ctc | gca | cca | ggc | gac | acc | atc | ttc | gaa | ggc | cga | aaa | atc | caa | tac | cca | 576 |
| Leu | Ala | Pro | Gly | Asp | Thr | Ile | Phe | Glu | Gly | Arg | Lys | Ile | Gln | Tyr | Pro | |
| | | | 180 | | | | | 185 | | | | | 190 | | | |
| cca | atg | cca | aaa | ttc | gcg | cca | gaa | cac | ttc | cgc | atc | ctg | cgc | gcc | aaa | 624 |
| Pro | Met | Pro | Lys | Phe | Ala | Pro | Glu | His | Phe | Arg | Ile | Leu | Arg | Ala | Lys | |
| | | 195 | | | | | 200 | | | | | 205 | | | | |
| tca | ctc | ggc | aaa | tac | aaa | cag | ttc | cgc | aaa | gcc | ctc | gag | cag | ctg | gac | 672 |
| Ser | Leu | Gly | Lys | Tyr | Lys | Gln | Phe | Arg | Lys | Ala | Leu | Glu | Gln | Leu | Asp | |
| | 210 | | | | | 215 | | | | | 220 | | | | | |
| tcc | gaa | ggt | gtc | gtc | cag | atc | ctc | aag | aac | gac | ctg | cgt | ggc | gac | gcc | 720 |
| Ser | Glu | Gly | Val | Val | Gln | Ile | Leu | Lys | Asn | Asp | Leu | Arg | Gly | Asp | Ala | |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 | |
| aac | cca | ggt | cat | ggc | cgg | tgt | | | | | | | | | | 741 |
| Asn | Pro | Gly | His | Gly | Arg | Cys | | | | | | | | | | |
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<210> 76

<211> 247

<212> PRT

<213> Corynebacterium glutamicum

<400> 76

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| Leu | Arg | Ser | Phe | Tyr | Thr | Pro | Glu | Gln | Ala | Ile | Glu | Arg | Glu | Gly | Asp |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |

Val Trp Lys Ala Ala Thr Glu Glu Ala Glu Leu Leu Ala Ala Asp Gly
 20 25 30
 Ala Val His Asp Gln Glu Leu Phe Leu Asn Cys Thr Thr Ser Pro Leu
 35 40 45
 Ile Phe Ala Ser Ala Met Leu Asn Phe Gly Val His Gln Ile Leu Asp
 50 55 60
 Thr Leu Cys Gln Leu Ala Pro Ser Pro Ala Gly Arg Asp Ala Asp Pro
 65 70 75 80
 Lys Ala Leu Glu Ala Ala Thr Ser Ala Met Asp Asp His Arg Asp Thr
 85 90 95
 Thr Asp Asp Phe Ser Gly Val Val Phe Lys Val Gln Ala Gly Met Asp
 100 105 110
 Lys Asn His Arg Asp Thr Leu Ala Phe Met Arg Val Val Ser Gly Glu
 115 120 125
 Phe Asp Arg Gly Met Gln Val Thr His Ser Gln Ser Gly Arg Ser Phe
 130 135 140
 Ser Thr Lys Tyr Ala Leu Thr Val Phe Gly Arg Thr Arg Ser Thr Val
 145 150 155 160
 Glu Thr Ala Phe Pro Gly Asp Ile Val Gly Leu Val Asn Ala Gly Ala
 165 170 175
 Leu Ala Pro Gly Asp Thr Ile Phe Glu Gly Arg Lys Ile Gln Tyr Pro
 180 185 190
 Pro Met Pro Lys Phe Ala Pro Glu His Phe Arg Ile Leu Arg Ala Lys
 195 200 205
 Ser Leu Gly Lys Tyr Lys Gln Phe Arg Lys Ala Leu Glu Gln Leu Asp
 210 215 220
 Ser Glu Gly Val Val Gln Ile Leu Lys Asn Asp Leu Arg Gly Asp Ala
 225 230 235 240
 Asn Pro Gly His Gly Arg Cys
 245

<210> 77
 <211> 478
 <212> DNA
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 <223> RXN02002

<400> 77

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<212> PRT
<213> Corynebacterium glutamicum
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|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Ser | Asn | Ala | Asn | Ser | Asp | Thr | Thr | Ala | Ala | Glu | Ala | His | Arg | Arg |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |
| Arg | Thr | Phe | Ala | Val | Ile | Ala | His | Pro | Asp | Ala | Gly | Lys | Ser | Thr | Leu |
| | | | 20 | | | | | 25 | | | | | 30 | | |
| Thr | Glu | Ala | Leu | Ala | Leu | His | Ala | His | Ile | Ile | Ser | Glu | Ala | Gly | Ala |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Thr | His | Gly | Lys | Ala | Gly | Arg | Lys | Ala | Thr | Val | Ser | Asp | Trp | Met | Glu |
| | 50 | | | | | 55 | | | | | 60 | | | | |

Met Glu Lys Asp Arg Gly Ile Ser Ile Ala Ser Ser Ala Leu Gln Phe
65 70 75 80

Glu Tyr Ala Pro Glu Gly His Ala Gly Glu Pro Phe Met Ile Asn Leu
85 90 95

Val Asp Thr Pro Gly His Ala Asp Phe Ser Glu Asp Thr Tyr Arg Val
100 105 110

Leu Met Ala Val Asp Ala Ala Val Met Leu Met His Ser Val
115 120 125

<210> 79

<211> 1080

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(1057)

<223> RXN02736

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acgggtcacac ctggcgcagg ccataattta ggggcaaaaa atg atc ttt gaa ctt 115
Met Ile Phe Glu Leu
1 5

ccg gat acc acc acc cag caa att tcc aag acc cta act cga ctg cgt 163
Pro Asp Thr Thr Thr Gln Gln Ile Ser Lys Thr Leu Thr Arg Leu Arg
10 15 20

gaa tcg ggc acc cag gtc acc acc ggc cga gtg ctc acc ctc atc gtg 211
Glu Ser Gly Thr Gln Val Thr Thr Gly Arg Val Leu Thr Leu Ile Val
25 30 35

gtc act gac tcc gaa agc gat gtc gct gca gtt acc gag tcc acc aat 259
Val Thr Asp Ser Glu Ser Asp Val Ala Ala Val Thr Glu Ser Thr Asn
40 45 50

gaa gcc tcg cgc gag cac cca tct cgc gtg atc att ttg gtg gtt ggc 307
Glu Ala Ser Arg Glu His Pro Ser Arg Val Ile Ile Leu Val Val Gly
55 60 65

gat aaa act gca gaa aac aaa gtt gac gca gaa gtc cgt atc ggt ggc 355
Asp Lys Thr Ala Glu Asn Lys Val Asp Ala Glu Val Arg Ile Gly Gly
70 75 80 85

gac gct ggt gct tcc gag atg atc atc atg cat ctc aac gga cct gtc 403
Asp Ala Gly Ala Ser Glu Met Ile Ile Met His Leu Asn Gly Pro Val
90 95 100

gct gac aag ctc cag tat gtc gtc aca cca ctg ttg ctt cct gac acc 451
Ala Asp Lys Leu Gln Tyr Val Val Thr Pro Leu Leu Leu Pro Asp Thr
105 110 115

ccc atc gtt gct tgg tgg cca ggt gaa tca cca aag aat cct tcc cag 499
 Pro Ile Val Ala Trp Trp Pro Gly Glu Ser Pro Lys Asn Pro Ser Gln
 120 125 130

gac cca att gga cgc atc gca caa cga cgc atc act gat gct ttg tac 547
 Asp Pro Ile Gly Arg Ile Ala Gln Arg Arg Ile Thr Asp Ala Leu Tyr
 135 140 145

gac cgt gat gac gca cta gaa gat cgt gtt gag aac tat cac cca ggt 595
 Asp Arg Asp Asp Ala Leu Glu Asp Arg Val Glu Asn Tyr His Pro Gly
 150 155 160 165

gat acc gac atg acg tgg gcg cgc ctt acc cag tgg cgg gga ctt gtt 643
 Asp Thr Asp Met Thr Trp Ala Arg Leu Thr Gln Trp Arg Gly Leu Val
 170 175 180

gcc tcc tca ttg gat cac cca cca cac agc gaa atc act tcc gtg agg 691
 Ala Ser Ser Leu Asp His Pro Pro His Ser Glu Ile Thr Ser Val Arg
 185 190 195

ctg acc ggt gca agc ggc agt acc tcg gtg gat ttg gct gca ggc tgg 739
 Leu Thr Gly Ala Ser Gly Ser Thr Ser Val Asp Leu Ala Ala Gly Trp
 200 205 210

ttg gcg cgg agg ctg aaa gtg cct gtg atc cgc gag gtg aca gat gct 787
 Leu Ala Arg Arg Leu Lys Val Pro Val Ile Arg Glu Val Thr Asp Ala
 215 220 225

ccc acc gtg cca acc gat gag ttt ggt act cca ctg ctg gct atc cag 835
 Pro Thr Val Pro Thr Asp Glu Phe Gly Thr Pro Leu Leu Ala Ile Gln
 230 235 240 245

cgc ctg gag atc gtt cgc acc acc ggc tcg atc atc atc acc atc tat 883
 Arg Leu Glu Ile Val Arg Thr Thr Gly Ser Ile Ile Ile Thr Ile Tyr
 250 255 260

gac gct cat acc ctt cag gta gag atg ccg gaa tcc ggc aat gcc cca 931
 Asp Ala His Thr Leu Gln Val Glu Met Pro Glu Ser Gly Asn Ala Pro
 265 270 275

tcg ctg gtg gct att ggt cgt cga agt gag tcc gac tgc ttg tct gag 979
 Ser Leu Val Ala Ile Gly Arg Arg Ser Glu Ser Asp Cys Leu Ser Glu
 280 285 290

gag ctt cgc cac atg gat cca gat ttg ggc tac cag cac gca cta tcc 1027
 Glu Leu Arg His Met Asp Pro Asp Leu Gly Tyr Gln His Ala Leu Ser
 295 300 305

ggc ttg tcc agc gtc aag ctg gaa acc gtc taaggagaaa tacaacacta 1077
 Gly Leu Ser Ser Val Lys Leu Glu Thr Val
 310 315

tgg 1080

<210> 80

<211> 319

<212> PRT

<213> Corynebacterium glutamicum

<400> 80

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 20 25 30

Leu Thr Leu Ile Val Val Thr Asp Ser Glu Ser Asp Val Ala Ala Val
 35 40 45

Thr Glu Ser Thr Asn Glu Ala Ser Arg Glu His Pro Ser Arg Val Ile
 50 55 60

Ile Leu Val Val Gly Asp Lys Thr Ala Glu Asn Lys Val Asp Ala Glu
 65 70 75 80

Val Arg Ile Gly Gly Asp Ala Gly Ala Ser Glu Met Ile Ile Met His
 85 90 95

Leu Asn Gly Pro Val Ala Asp Lys Leu Gln Tyr Val Val Thr Pro Leu
 100 105 110

Leu Leu Pro Asp Thr Pro Ile Val Ala Trp Trp Pro Gly Glu Ser Pro
 115 120 125

Lys Asn Pro Ser Gln Asp Pro Ile Gly Arg Ile Ala Gln Arg Arg Ile
 130 135 140

Thr Asp Ala Leu Tyr Asp Arg Asp Asp Ala Leu Glu Asp Arg Val Glu
 145 150 155 160

Asn Tyr His Pro Gly Asp Thr Asp Met Thr Trp Ala Arg Leu Thr Gln
 165 170 175

Trp Arg Gly Leu Val Ala Ser Ser Leu Asp His Pro Pro His Ser Glu
 180 185 190

Ile Thr Ser Val Arg Leu Thr Gly Ala Ser Gly Ser Thr Ser Val Asp
 195 200 205

Leu Ala Ala Gly Trp Leu Ala Arg Arg Leu Lys Val Pro Val Ile Arg
 210 215 220

Glu Val Thr Asp Ala Pro Thr Val Pro Thr Asp Glu Phe Gly Thr Pro
 225 230 235 240

Leu Leu Ala Ile Gln Arg Leu Glu Ile Val Arg Thr Thr Gly Ser Ile
 245 250 255

Ile Ile Thr Ile Tyr Asp Ala His Thr Leu Gln Val Glu Met Pro Glu
 260 265 270

Ser Gly Asn Ala Pro Ser Leu Val Ala Ile Gly Arg Arg Ser Glu Ser

275 280 285
 Asp Cys Leu Ser Glu Glu Leu Arg His Met Asp Pro Asp Leu Gly Tyr
 290 295 300

Gln His Ala Leu Ser Gly Leu Ser Ser Val Lys Leu Glu Thr Val
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<210> 81
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<220>
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 Met Ala Gln Gly Thr
 1 5
 gtg aaa tgg ttc aac ggc gaa aag gga ttt ggt ttc atc gct ccc aac 163
 Val Lys Trp Phe Asn Gly Glu Lys Gly Phe Gly Phe Ile Ala Pro Asn
 10 15 20
 gat ggc tcc gca gat ctc ttc gtc cac tac tct gag att cag ggc tcc 211
 Asp Gly Ser Ala Asp Leu Phe Val His Tyr Ser Glu Ile Gln Gly Ser
 25 30 35
 ggt ttc cgt aat ctt gag gaa aac cag cca gtt gaa ttt gag gtc ggc 259
 Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val Glu Phe Glu Val Gly
 40 45 50
 gag ggc gcc aag ggc cca cag gct cag cag gtt cgt gct ctc 301
 Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val Arg Ala Leu
 55 60 65
 taagctctaa ctgctagcta aaaattccgc 331

<210> 82
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<400> 82
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 Phe Ile Ala Pro Asn Asp Gly Ser Ala Asp Leu Phe Val His Tyr Ser
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Glu Ile Gln Gly Ser Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val
 35 40 45

Glu Phe Glu Val Gly Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val
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Arg Ala Leu
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 Met Ala Gln Gly Thr
 1 5
 gtg aaa tgg ttc aac ggc gaa aag gga ttt ggt ttc atc gct ccc aac 163
 Val Lys Trp Phe Asn Gly Glu Lys Gly Phe Gly Phe Ile Ala Pro Asn
 10 15 20
 gat ggc tcc gca gat ctc ttc gtc cac tac tct gag att cag ggc tcc 211
 Asp Gly Ser Ala Asp Leu Phe Val His Tyr Ser Glu Ile Gln Gly Ser
 25 30 35
 ggt ttc cgt aat ctt gag gaa aac cag cca gtt gaa ttt gag gtc ggc 259
 Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val Glu Phe Glu Val Gly
 40 45 50
 gag ggc gcc aag ggc cca cag gct cag cag gtt cgt gct ctc 301
 Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val Arg Ala Leu
 55 60 65
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 20 25 30

Glu Ile Gln Gly Ser Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val
 35 40 45

Glu Phe Glu Val Gly Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val
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Arg Ala Leu
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 gaatcagcat atgaattagg aatgaaagtg gtgaggacaa gtg cct gtc gga aca 115
 Val Pro Val Gly Thr
 1 5
 gtg aag tgg tac gac gcg gag cgt ggt ttc ggc ttt gtc tcc aat cca 163
 Val Lys Trp Tyr Asp Ala Glu Arg Gly Phe Gly Phe Val Ser Asn Pro
 10 15 20
 ggt ggt gaa gat tgc ttc gta ggt aag caa gta ctt ccc aag gga gtc 211
 Gly Gly Glu Asp Cys Phe Val Gly Lys Gln Val Leu Pro Lys Gly Val
 25 30 35
 acc gaa ttg cac aag gga cag cga atc gat ttt gac ttc gcc gca ggc 259
 Thr Glu Leu His Lys Gly Gln Arg Ile Asp Phe Asp Phe Ala Ala Gly
 40 45 50
 cgt aag ggc cct caa gca ctt cga ata aag att ctt gaa act cca cgc 307
 Arg Lys Gly Pro Gln Ala Leu Arg Ile Lys Ile Leu Glu Thr Pro Arg
 55 60 65
 agg cgt cca cag cac aaa tac aag cca gaa gag ctc aac gga atg atc 355
 Arg Arg Pro Gln His Lys Tyr Lys Pro Glu Glu Leu Asn Gly Met Ile
 70 75 80 85
 tct gac ctc atc acg ctt cta gaa agt gga gtg caa cca ggc ctt gcc 403
 Ser Asp Leu Ile Thr Leu Leu Glu Ser Gly Val Gln Pro Gly Leu Ala
 90 95 100
 aaa ggg caa tac ccg gag cac aaa gct gga gcg cag gta gca gaa att 451
 Lys Gly Gln Tyr Pro Glu His Lys Ala Gly Ala Gln Val Ala Glu Ile
 105 110 115
 ctt cgc gtt gtt gcg aag gag ctt gag tct taaaacaata aggagaggat 501

Leu Arg Val Val Ala Lys Glu Leu Glu Ser
 120 125

ccg

504

<210> 86
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<400> 86
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 35 40 45
 Asp Phe Ala Ala Gly Arg Lys Gly Pro Gln Ala Leu Arg Ile Lys Ile
 50 55 60
 Leu Glu Thr Pro Arg Arg Arg Pro Gln His Lys Tyr Lys Pro Glu Glu
 65 70 75 80
 Leu Asn Gly Met Ile Ser Asp Leu Ile Thr Leu Leu Glu Ser Gly Val
 85 90 95
 Gln Pro Gly Leu Ala Lys Gly Gln Tyr Pro Glu His Lys Ala Gly Ala
 100 105 110
 Gln Val Ala Glu Ile Leu Arg Val Val Ala Lys Glu Leu Glu Ser
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 <212> DNA
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 <222> (101)..(301)
 <223> RXA00810

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 Met Ala Gln Gly Thr
 1 5
 gtt aag tgg ttc aac cca gag aag ggc ttc ggc ttc atc gct cct tcc 163
 Val Lys Trp Phe Asn Pro Glu Lys Gly Phe Gly Phe Ile Ala Pro Ser
 10 15 20

gac gga tcc gct gac gtt ttc gtc cac tac tcc gag atc gag ggc aac 211
 Asp Gly Ser Ala Asp Val Phe Val His Tyr Ser Glu Ile Glu Gly Asn
 25 30 35

ggc ttc cgt acc ctc gag gag aac cag ctc gtc gag ttc gaa atc ggc 259
 Gly Phe Arg Thr Leu Glu Glu Asn Gln Leu Val Glu Phe Glu Ile Gly
 40 45 50

gag ggc gct aag ggc ctt cag gct cag gct gtt cgt gca atc 301
 Glu Gly Ala Lys Gly Leu Gln Ala Gln Ala Val Arg Ala Ile
 55 60 65

taattgcatc tgagttcgaa acc 324

<210> 88
 <211> 67
 <212> PRT
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<400> 88
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 Glu Ile Glu Gly Asn Gly Phe Arg Thr Leu Glu Glu Asn Gln Leu Val
 35 40 45
 Glu Phe Glu Ile Gly Glu Gly Ala Lys Gly Leu Gln Ala Gln Ala Val
 50 55 60
 Arg Ala Ile
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<210> 89
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 <212> DNA
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cggtagacgg tactttcata tccaccata taatgttgat atg gat aat ggg tgg 115
 Met Asp Asn Gly Trp
 1 5

ccg aac ctg caa act ctc gca ctc ttt gtg gcg att gtg gaa gag ggg 163
 Pro Asn Leu Gln Thr Leu Ala Leu Phe Val Ala Ile Val Glu Glu Gly

| | 10 | 15 | 20 | |
|---|-----|-----|-----|-----|
| agc ctc ggt gcc ggt gct cga aaa gtc gga atg gcc caa cct aat gcc | | | | 211 |
| Ser Leu Gly Ala Gly Ala Arg Lys Val Gly Met Ala Gln Pro Asn Ala | | | | |
| | 25 | 30 | 35 | |
| agt cgg gct atc gca gag ctt gag gca gac atg aaa gcc gaa ttg ttg | | | | 259 |
| Ser Arg Ala Ile Ala Glu Leu Glu Ala Asp Met Lys Ala Glu Leu Leu | | | | |
| | 40 | 45 | 50 | |
| gta cgt cat cct cga gga tca cat cca aca gct gct gga ctt gcg ctt | | | | 307 |
| Val Arg His Pro Arg Gly Ser His Pro Thr Ala Ala Gly Leu Ala Leu | | | | |
| | 55 | 60 | 65 | |
| gtt gag cat tcg cgc gat ctg ctt caa tct gta caa gaa ttt act gaa | | | | 355 |
| Val Glu His Ser Arg Asp Leu Leu Gln Ser Val Gln Glu Phe Thr Glu | | | | |
| | 70 | 75 | 80 | 85 |
| tgg gtg aca gag gga cga act gag cag ccg ctg aaa ttg cat gtt ggg | | | | 403 |
| Trp Val Thr Glu Gly Arg Thr Glu Gln Pro Leu Lys Leu His Val Gly | | | | |
| | 90 | 95 | 100 | |
| gcc agt atg acc att gcc gag gct cta ctt cca gct tgg gtt gcg gac | | | | 451 |
| Ala Ser Met Thr Ile Ala Glu Ala Leu Leu Pro Ala Trp Val Ala Asp | | | | |
| | 105 | 110 | 115 | |
| atg cgc acg cgt ttt cct gcc tgc cgt gtc gac gtc tct gtg atg aat | | | | 499 |
| Met Arg Thr Arg Phe Pro Ala Cys Arg Val Asp Val Ser Val Met Asn | | | | |
| | 120 | 125 | 130 | |
| tct tct caa gta att gaa gcc gtc cag aaa ggg cac ttg caa cta ggt | | | | 547 |
| Ser Ser Gln Val Ile Glu Ala Val Gln Lys Gly His Leu Gln Leu Gly | | | | |
| | 135 | 140 | 145 | |
| ttt att gaa aca ccg cat gtt ccc gta cgg ctt cat gct cgt gtg gtg | | | | 595 |
| Phe Ile Glu Thr Pro His Val Pro Val Arg Leu His Ala Arg Val Val | | | | |
| | 150 | 155 | 160 | 165 |
| caa gag gac aag ctg att gtg gtg att tct cct aat cat gag tgg gct | | | | 643 |
| Gln Glu Asp Lys Leu Ile Val Val Ile Ser Pro Asn His Glu Trp Ala | | | | |
| | 170 | 175 | 180 | |
| aat cgc acg ggt agg atc agt ctt cgg gag ttg tcg gaa act ccg ctg | | | | 691 |
| Asn Arg Thr Gly Arg Ile Ser Leu Arg Glu Leu Ser Glu Thr Pro Leu | | | | |
| | 185 | 190 | 195 | |
| ata gtg agg gaa gtc ggc tca ggt acc cga gaa gca tta caa gaa tta | | | | 739 |
| Ile Val Arg Glu Val Gly Ser Gly Thr Arg Glu Ala Leu Gln Glu Leu | | | | |
| | 200 | 205 | 210 | |
| ctt gcg gat tat gac atg gct gag ccg att caa gtg tta aac agc aat | | | | 787 |
| Leu Ala Asp Tyr Asp Met Ala Glu Pro Ile Gln Val Leu Asn Ser Asn | | | | |
| | 215 | 220 | 225 | |
| gct gcg gta cgt gtt gtt gtt gaa gca ggg gca ggt cct gca gta ctt | | | | 835 |
| Ala Ala Val Arg Val Val Val Glu Ala Gly Ala Gly Pro Ala Val Leu | | | | |
| | 230 | 235 | 240 | 245 |

ggt gaa tta gcc ttg cgt gat cat ctt gcg ctc ggc agg ctg ttg agt 883
 Gly Glu Leu Ala Leu Arg Asp His Leu Ala Leu Gly Arg Leu Leu Ser
 250 255 260

gtg cca ttt gaa ggc agt gga gtt act cgt cct ctt aca gct gtg tgg 931
 Val Pro Phe Glu Gly Ser Gly Val Thr Arg Pro Leu Thr Ala Val Trp
 265 270 275

agt gga ccc cgc aga ttg ccg att cta gcg gga gaa tta gtg tcc atc 979
 Ser Gly Pro Arg Arg Leu Pro Ile Leu Ala Gly Glu Leu Val Ser Ile
 280 285 290

gca tcg aac cac atc tgattttgag ccctggctaa cgg 1017
 Ala Ser Asn His Ile
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<210> 90
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 <212> PRT
 <213> Corynebacterium glutamicum

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 35 40 45

Lys Ala Glu Leu Leu Val Arg His Pro Arg Gly Ser His Pro Thr Ala
 50 55 60

Ala Gly Leu Ala Leu Val Glu His Ser Arg Asp Leu Leu Gln Ser Val
 65 70 75 80

Gln Glu Phe Thr Glu Trp Val Thr Glu Gly Arg Thr Glu Gln Pro Leu
 85 90 95

Lys Leu His Val Gly Ala Ser Met Thr Ile Ala Glu Ala Leu Leu Pro
 100 105 110

Ala Trp Val Ala Asp Met Arg Thr Arg Phe Pro Ala Cys Arg Val Asp
 115 120 125

Val Ser Val Met Asn Ser Ser Gln Val Ile Glu Ala Val Gln Lys Gly
 130 135 140

His Leu Gln Leu Gly Phe Ile Glu Thr Pro His Val Pro Val Arg Leu
 145 150 155 160

His Ala Arg Val Val Gln Glu Asp Lys Leu Ile Val Val Ile Ser Pro
 165 170 175

Asn His Glu Trp Ala Asn Arg Thr Gly Arg Ile Ser Leu Arg Glu Leu
 180 185 190
 Ser Glu Thr Pro Leu Ile Val Arg Glu Val Gly Ser Gly Thr Arg Glu
 195 200 205
 Ala Leu Gln Glu Leu Leu Ala Asp Tyr Asp Met Ala Glu Pro Ile Gln
 210 215 220
 Val Leu Asn Ser Asn Ala Ala Val Arg Val Val Val Glu Ala Gly Ala
 225 230 235 240
 Gly Pro Ala Val Leu Gly Glu Leu Ala Leu Arg Asp His Leu Ala Leu
 245 250 255
 Gly Arg Leu Leu Ser Val Pro Phe Glu Gly Ser Gly Val Thr Arg Pro
 260 265 270
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 275 280 285
 Glu Leu Val Ser Ile Ala Ser Asn His Ile
 290 295

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 <213> Corynebacterium glutamicum

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 <222> (1)..(1191)
 <223> RXA02431

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 Val Phe Gln Ile Val Glu Lys Arg Ala Gly Ile Val Glu Arg Leu Ser
 20 25 30
 atc gat gaa ggc ttc atg gaa cca gag gct ctc gtt gga gcc acc cca 144
 Ile Asp Glu Gly Phe Met Glu Pro Glu Ala Leu Val Gly Ala Thr Pro
 35 40 45
 gaa gag gtg aaa cag tgg gcg gaa gaa tta cgc gcg gaa att aaa gaa 192
 Glu Glu Val Lys Gln Trp Ala Glu Glu Leu Arg Ala Glu Ile Lys Glu
 50 55 60
 gtt act ggc tta ccc tcc tcg gtt ggt gct ggc tcc ggt aag cag atc 240
 Val Thr Gly Leu Pro Ser Ser Val Gly Ala Gly Ser Gly Lys Gln Ile
 65 70 75 80
 gcc aaa att ggt tca ggc gaa gca aag cca gat ggt gtg ttt gtc gtg 288

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Ala | Lys | Ile | Gly | Ser | Gly | Glu | Ala | Lys | Pro | Asp | Gly | Val | Phe | Val | Val | | |
| | | | | 85 | | | | | 90 | | | | | 95 | | | |
| cca | gta | gac | aag | caa | cat | gac | ttg | ctt | gat | cca | ctt | cct | gtg | ggc | gca | 336 | |
| Pro | Val | Asp | Lys | Gln | His | Asp | Leu | Leu | Asp | Pro | Leu | Pro | Val | Gly | Ala | | |
| | | | 100 | | | | | 105 | | | | | 110 | | | | |
| ctt | tgg | gga | gtg | ggt | cct | gtg | aca | ggc | tcc | aag | ctt | gcc | tca | atg | ggg | 384 | |
| Leu | Trp | Gly | Val | Gly | Pro | Val | Thr | Gly | Ser | Lys | Leu | Ala | Ser | Met | Gly | | |
| | | 115 | | | | | 120 | | | | | 125 | | | | | |
| gtg | gaa | aca | att | ggt | gat | cta | gca | gcg | cta | acc | caa | aaa | gaa | gta | gaa | 432 | |
| Val | Glu | Thr | Ile | Gly | Asp | Leu | Ala | Ala | Leu | Thr | Gln | Lys | Glu | Val | Glu | | |
| | 130 | | | | | 135 | | | | | 140 | | | | | | |
| atc | agc | ctc | ggt | gca | acc | atc | gga | ata | tca | ctg | tgg | aac | ctt | gcc | cga | 480 | |
| Ile | Ser | Leu | Gly | Ala | Thr | Ile | Gly | Ile | Ser | Leu | Trp | Asn | Leu | Ala | Arg | | |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 | | |
| gga | atc | gac | gac | cgc | cct | gtg | gaa | ccc | cgc | gcc | gaa | gca | aaa | cag | atc | 528 | |
| Gly | Ile | Asp | Asp | Arg | Pro | Val | Glu | Pro | Arg | Ala | Glu | Ala | Lys | Gln | Ile | | |
| | | | | 165 | | | | | 170 | | | | | 175 | | | |
| tcc | caa | gag | cac | acc | tat | gaa | aaa | gac | ctc | ctc | acc | agg | caa | caa | gta | 576 | |
| Ser | Gln | Glu | His | Thr | Tyr | Glu | Lys | Asp | Leu | Leu | Thr | Arg | Gln | Gln | Val | | |
| | | | 180 | | | | | 185 | | | | | 190 | | | | |
| gat | gct | gcc | atc | att | cga | tca | gcc | gaa | ggc | gca | cac | cga | cgg | ctc | ctc | 624 | |
| Asp | Ala | Ala | Ile | Ile | Arg | Ser | Ala | Glu | Gly | Ala | His | Arg | Arg | Leu | Leu | | |
| | | 195 | | | | | 200 | | | | | 205 | | | | | |
| aaa | gac | gga | cgc | ggt | gcc | aga | act | gtc | agc | gtg | aaa | ctg | cgg | atg | gcc | 672 | |
| Lys | Asp | Gly | Arg | Gly | Ala | Arg | Thr | Val | Ser | Val | Lys | Leu | Arg | Met | Ala | | |
| | 210 | | | | | 215 | | | | | 220 | | | | | | |
| gac | ttt | cgt | att | gag | tct | cgt | tcc | tac | acc | ttg | tcc | tat | gcc | acc | gat | 720 | |
| Asp | Phe | Arg | Ile | Glu | Ser | Arg | Ser | Tyr | Thr | Leu | Ser | Tyr | Ala | Thr | Asp | | |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 | | |
| gat | tac | gca | act | ctt | gag | gca | aca | gca | ttc | cga | ctt | gcc | cgc | tac | ccc | 768 | |
| Asp | Tyr | Ala | Thr | Leu | Glu | Ala | Thr | Ala | Phe | Arg | Leu | Ala | Arg | Tyr | Pro | | |
| | | | 245 | | | | | 250 | | | | | | 255 | | | |
| gga | gaa | gta | ggc | ccc | atc | cgc | ctt | gtc | gga | gta | agt | ttt | tct | ggt | ttg | 816 | |
| Gly | Glu | Val | Gly | Pro | Ile | Arg | Leu | Val | Gly | Val | Ser | Phe | Ser | Gly | Leu | | |
| | | | 260 | | | | | 265 | | | | | 270 | | | | |
| gaa | gaa | tcc | cgc | caa | gac | atc | ctc | ttc | ccg | gaa | ctt | gac | caa | caa | atc | 864 | |
| Glu | Glu | Ser | Arg | Gln | Asp | Ile | Leu | Phe | Pro | Glu | Leu | Asp | Gln | Gln | Ile | | |
| | | 275 | | | | | 280 | | | | | 285 | | | | | |
| atc | gta | cca | cca | gca | ccc | gac | acc | gat | tat | gag | gta | ggc | gtg | caa | tcc | 912 | |
| Ile | Val | Pro | Pro | Ala | Pro | Asp | Thr | Asp | Tyr | Glu | Val | Gly | Val | Gln | Ser | | |
| | 290 | | | | | 295 | | | | | 300 | | | | | | |
| tct | tct | agt | tcc | gaa | agt | act | caa | gtt | gaa | gcg | ccg | caa | gat | gtc | gcg | 960 | |
| Ser | Ser | Ser | Ser | Glu | Ser | Thr | Gln | Val | Glu | Ala | Pro | Gln | Asp | Val | Ala | | |

305 310 315 320
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 His Gly Trp Val Gln Gly Ala Gly His Gly Val Val Ser Val Arg Phe
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 355 360 365
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 370 375 380
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 <211> 397
 <212> PRT
 <213> Corynebacterium glutamicum

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 35 40 45
 Glu Glu Val Lys Gln Trp Ala Glu Glu Leu Arg Ala Glu Ile Lys Glu
 50 55 60
 Val Thr Gly Leu Pro Ser Ser Val Gly Ala Gly Ser Gly Lys Gln Ile
 65 70 75 80
 Ala Lys Ile Gly Ser Gly Glu Ala Lys Pro Asp Gly Val Phe Val Val
 85 90 95
 Pro Val Asp Lys Gln His Asp Leu Leu Asp Pro Leu Pro Val Gly Ala
 100 105 110
 Leu Trp Gly Val Gly Pro Val Thr Gly Ser Lys Leu Ala Ser Met Gly
 115 120 125
 Val Glu Thr Ile Gly Asp Leu Ala Ala Leu Thr Gln Lys Glu Val Glu
 130 135 140

Ile Ser Leu Gly Ala Thr Ile Gly Ile Ser Leu Trp Asn Leu Ala Arg
 145 150 155 160
 Gly Ile Asp Asp Arg Pro Val Glu Pro Arg Ala Glu Ala Lys Gln Ile
 165 170 175
 Ser Gln Glu His Thr Tyr Glu Lys Asp Leu Leu Thr Arg Gln Gln Val
 180 185 190
 Asp Ala Ala Ile Ile Arg Ser Ala Glu Gly Ala His Arg Arg Leu Leu
 195 200 205
 Lys Asp Gly Arg Gly Ala Arg Thr Val Ser Val Lys Leu Arg Met Ala
 210 215 220
 Asp Phe Arg Ile Glu Ser Arg Ser Tyr Thr Leu Ser Tyr Ala Thr Asp
 225 230 235 240
 Asp Tyr Ala Thr Leu Glu Ala Thr Ala Phe Arg Leu Ala Arg Tyr Pro
 245 250 255
 Gly Glu Val Gly Pro Ile Arg Leu Val Gly Val Ser Phe Ser Gly Leu
 260 265 270
 Glu Glu Ser Arg Gln Asp Ile Leu Phe Pro Glu Leu Asp Gln Gln Ile
 275 280 285
 Ile Val Pro Pro Ala Pro Asp Thr Asp Tyr Glu Val Gly Val Gln Ser
 290 295 300
 Ser Ser Ser Ser Glu Ser Thr Gln Val Glu Ala Pro Gln Asp Val Ala
 305 310 315 320
 Leu Ser Met Trp Cys Ala Thr Gln Asp Val Tyr His Pro Glu Tyr Gly
 325 330 335
 His Gly Trp Val Gln Gly Ala Gly His Gly Val Val Ser Val Arg Phe
 340 345 350
 Glu Thr Arg Ser Thr Thr Lys Gly Arg Thr Lys Ser Phe Ser Met Asp
 355 360 365
 Asp Pro Asp Leu Thr Pro Ala Asp Pro Leu Asp Ser Leu Asp Trp Ala
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 Asp Trp Phe Ala Glu Asn Gly Glu Thr Gly Asp Asp Glu
 385 390 395

<210> 93

<211> 558

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(535)

<223> RXA02446

<400> 93

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gagcgtattc tttgtgttct ctcacgacag gaatactgct atg gcg atc gag tcc 115
                               Met Ala Ile Glu Ser
                               1                               5

atc gcg tac acc agt gaa gca ctc tca acc ggc agt ggc cgg ctg ggg 163
Ile Ala Tyr Thr Ser Glu Ala Leu Ser Thr Gly Ser Gly Arg Leu Gly
                        10                        15                        20

cat gtg cgc tcc aca gat ggt gcg ctc gaa ttt gaa atg aca ccg cca 211
His Val Arg Ser Thr Asp Gly Ala Leu Glu Phe Glu Met Thr Pro Pro
                        25                        30                        35

aag gct ttg ggc gga tcc ggt gaa ggc acc aat cca gaa cag ctg ttc 259
Lys Ala Leu Gly Gly Ser Gly Glu Gly Thr Asn Pro Glu Gln Leu Phe
                        40                        45                        50

gcg gta ggt tac gca gcc tgt ttc cac tct gcc atg cac tct gtc gca 307
Ala Val Gly Tyr Ala Ala Cys Phe His Ser Ala Met His Ser Val Ala
                        55                        60                        65

cgc agc cgc aag atc act ctt gaa gac aca gcg gtt ggt gcc cga gtt 355
Arg Ser Arg Lys Ile Thr Leu Glu Asp Thr Ala Val Gly Ala Arg Val
                        70                        75                        80                        85

agc atc ggg cca aac ggc gct ggt gga ttt gag att gcc gta gaa ctc 403
Ser Ile Gly Pro Asn Gly Ala Gly Gly Phe Glu Ile Ala Val Glu Leu
                        90                        95                        100

gaa gta tcg att cct caa ttg cca caa gca gaa gcc cag gaa ctt gct 451
Glu Val Ser Ile Pro Gln Leu Pro Gln Ala Glu Ala Gln Glu Leu Ala
                        105                        110                        115

gat gcc gcg cac cag gtg tgc ccg tat tcc aac gcc aca cga ggc aat 499
Asp Ala Ala His Gln Val Cys Pro Tyr Ser Asn Ala Thr Arg Gly Asn
                        120                        125                        130

atc tcg gta act gtg tca gtc atc gac gaa gag gct taaaaccaca 545
Ile Ser Val Thr Val Ser Val Ile Asp Glu Glu Ala
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ggattaacaa aac 558

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<213> Corynebacterium glutamicum

<400> 94

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 Glu Met Thr Pro Pro Lys Ala Leu Gly Gly Ser Gly Glu Gly Thr Asn
 35 40 45
 Pro Glu Gln Leu Phe Ala Val Gly Tyr Ala Ala Cys Phe His Ser Ala
 50 55 60
 Met His Ser Val Ala Arg Ser Arg Lys Ile Thr Leu Glu Asp Thr Ala
 65 70 75 80
 Val Gly Ala Arg Val Ser Ile Gly Pro Asn Gly Ala Gly Gly Phe Glu
 85 90 95
 Ile Ala Val Glu Leu Glu Val Ser Ile Pro Gln Leu Pro Gln Ala Glu
 100 105 110
 Ala Gln Glu Leu Ala Asp Ala Ala His Gln Val Cys Pro Tyr Ser Asn
 115 120 125
 Ala Thr Arg Gly Asn Ile Ser Val Thr Val Ser Val Ile Asp Glu Glu
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Ala
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 <223> RXA02861

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 Met Ser Thr Arg Thr
 1 5
 acg cca caa gac cgt tat acc gac gaa tac ggc atc gaa cgc gtc aac 163
 Thr Pro Gln Asp Arg Tyr Thr Asp Glu Tyr Gly Ile Glu Arg Val Asn
 10 15 20
 aag gat gaa ccc ggc ctg gtg gac aaa ctc cgg gac aag cac gac tgg 211
 Lys Asp Glu Pro Gly Leu Val Asp Lys Leu Arg Asp Lys His Asp Trp
 25 30 35
 ttt gat cat ctc atg cgc atg aat gaa cgt ttc ggc gca aaa ggt ggc 259
 Phe Asp His Leu Met Arg Met Asn Glu Arg Phe Gly Ala Lys Gly Gly
 40 45 50

| | |
|---|-----|
| aac caa ttg tcg gcg ggt att acg tat ttc tcc gtg ctg tcg atc ttc | 307 |
| Asn Gln Leu Ser Ala Gly Ile Thr Tyr Phe Ser Val Leu Ser Ile Phe | |
| 55 60 65 | |
| ccg att gcc atg ctt gtc ttc ggt att gca ggt gtc atc ctt gcc gga | 355 |
| Pro Ile Ala Met Leu Val Phe Gly Ile Ala Gly Val Ile Leu Ala Gly | |
| 70 75 80 85 | |
| aac cct gaa gtt ctc aca gat att caa aat cga atc aac gat gct tta | 403 |
| Asn Pro Glu Val Leu Thr Asp Ile Gln Asn Arg Ile Asn Asp Ala Leu | |
| 90 95 100 | |
| gaa ggc gag atc ggt aac acc gtc aac ggc atc att gat tcc gcg att | 451 |
| Glu Gly Glu Ile Gly Asn Thr Val Asn Gly Ile Ile Asp Ser Ala Ile | |
| 105 110 115 | |
| gcg cag cgt ggt gct gtg ttg ggc att ggt ggt gta act gcc ctg tgg | 499 |
| Ala Gln Arg Gly Ala Val Leu Gly Ile Gly Gly Val Thr Ala Leu Trp | |
| 120 125 130 | |
| tct gga ctg ggg tgg atg gcg aac ctg cgc ttt gga gtt tcc cgc atg | 547 |
| Ser Gly Leu Gly Trp Met Ala Asn Leu Arg Phe Gly Val Ser Arg Met | |
| 135 140 145 | |
| tgg gcc att gac cca act gaa ggc aac ttc att caa aag aag ctc acc | 595 |
| Trp Ala Ile Asp Pro Thr Glu Gly Asn Phe Ile Gln Lys Lys Leu Thr | |
| 150 155 160 165 | |
| gac ttg gtc gcg ctg atc gtc ttg ctg ctg gcc atg ggc gta gcc ttc | 643 |
| Asp Leu Val Ala Leu Ile Val Leu Leu Leu Ala Met Gly Val Ala Phe | |
| 170 175 180 | |
| ggt atc acg gcg ctc ggt gct tcc gga cta acc aaa aac ctg ctg gac | 691 |
| Gly Ile Thr Ala Leu Gly Ala Ser Gly Leu Thr Lys Asn Leu Leu Asp | |
| 185 190 195 | |
| ttt gtg ggc ctg ggg gag att ccg ggc att agc tac atc acc tgg gtg | 739 |
| Phe Val Gly Leu Gly Glu Ile Pro Gly Ile Ser Tyr Ile Thr Trp Val | |
| 200 205 210 | |
| gtc gca gca ctt gtt ggt gtc ttg gct aac ttc ctg gtg ttc atg tgg | 787 |
| Val Ala Ala Leu Val Gly Val Leu Ala Asn Phe Leu Val Phe Met Trp | |
| 215 220 225 | |
| ctg att ttc tcc ctg cca cgt acc aaa gtt ccc atg aaa ccg ggt ctt | 835 |
| Leu Ile Phe Ser Leu Pro Arg Thr Lys Val Pro Met Lys Pro Gly Leu | |
| 230 235 240 245 | |
| cag gca gca ctg ctt ggc gca atc ggt ttt gag gtg gtc aag cag gtt | 883 |
| Gln Ala Ala Leu Leu Gly Ala Ile Gly Phe Glu Val Val Lys Gln Val | |
| 250 255 260 | |
| gga tcg ctg ttg gct tca aat gca ttg agt aac ccc gcg ggt gca gca | 931 |
| Gly Ser Leu Leu Ala Ser Asn Ala Leu Ser Asn Pro Ala Gly Ala Ala | |
| 265 270 275 | |

ttc ggt ccg atc atc ggc atc atg gtt gtg ctg tat ttg atc tgg cgc 979
 Phe Gly Pro Ile Ile Gly Ile Met Val Val Leu Tyr Leu Ile Trp Arg
 280 285 290

atc ctc atg tat tgc tct gcg tgg gct gcc acc agt gaa gaa gcg ttg 1027
 Ile Leu Met Tyr Cys Ser Ala Trp Ala Ala Thr Ser Glu Glu Ala Leu
 295 300 305

cgt ctt gcg act gtt cca gca cca gag cct gcg atc att cgg gtt cgc 1075
 Arg Leu Ala Thr Val Pro Ala Pro Glu Pro Ala Ile Ile Arg Val Arg
 310 315 320 325

cat gaa att gat cca ggt gaa gaa gtc tcc caa tct gct cga aaa gtg 1123
 His Glu Ile Asp Pro Gly Glu Glu Val Ser Gln Ser Ala Arg Lys Val
 330 335 340

ggc att gga gtg gcc gtg ggt gcc gcg act gcg ggt gct ttt gcg ctg 1171
 Gly Ile Gly Val Ala Val Gly Ala Ala Thr Ala Gly Ala Phe Ala Leu
 345 350 355

ttg cgt aaa aaa tagtttttat taagggcatt ccc 1206
 Leu Arg Lys Lys
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<210> 96
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 <212> PRT
 <213> Corynebacterium glutamicum

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Asp Lys His Asp Trp Phe Asp His Leu Met Arg Met Asn Glu Arg Phe
 35 40 45

Gly Ala Lys Gly Gly Asn Gln Leu Ser Ala Gly Ile Thr Tyr Phe Ser
 50 55 60

Val Leu Ser Ile Phe Pro Ile Ala Met Leu Val Phe Gly Ile Ala Gly
 65 70 75 80

Val Ile Leu Ala Gly Asn Pro Glu Val Leu Thr Asp Ile Gln Asn Arg
 85 90 95

Ile Asn Asp Ala Leu Glu Gly Glu Ile Gly Asn Thr Val Asn Gly Ile
 100 105 110

Ile Asp Ser Ala Ile Ala Gln Arg Gly Ala Val Leu Gly Ile Gly Gly
 115 120 125

Val Thr Ala Leu Trp Ser Gly Leu Gly Trp Met Ala Asn Leu Arg Phe
 130 135 140

Gly Val Ser Arg Met Trp Ala Ile Asp Pro Thr Glu Gly Asn Phe Ile
 145 150 155 160
 Gln Lys Lys Leu Thr Asp Leu Val Ala Leu Ile Val Leu Leu Leu Ala
 165 170 175
 Met Gly Val Ala Phe Gly Ile Thr Ala Leu Gly Ala Ser Gly Leu Thr
 180 185 190
 Lys Asn Leu Leu Asp Phe Val Gly Leu Gly Glu Ile Pro Gly Ile Ser
 195 200 205
 Tyr Ile Thr Trp Val Val Ala Ala Leu Val Gly Val Leu Ala Asn Phe
 210 215 220
 Leu Val Phe Met Trp Leu Ile Phe Ser Leu Pro Arg Thr Lys Val Pro
 225 230 235 240
 Met Lys Pro Gly Leu Gln Ala Ala Leu Leu Gly Ala Ile Gly Phe Glu
 245 250 255
 Val Val Lys Gln Val Gly Ser Leu Leu Ala Ser Asn Ala Leu Ser Asn
 260 265 270
 Pro Ala Gly Ala Ala Phe Gly Pro Ile Ile Gly Ile Met Val Val Leu
 275 280 285
 Tyr Leu Ile Trp Arg Ile Leu Met Tyr Cys Ser Ala Trp Ala Ala Thr
 290 295 300
 Ser Glu Glu Ala Leu Arg Leu Ala Thr Val Pro Ala Pro Glu Pro Ala
 305 310 315 320
 Ile Ile Arg Val Arg His Glu Ile Asp Pro Gly Glu Glu Val Ser Gln
 325 330 335
 Ser Ala Arg Lys Val Gly Ile Gly Val Ala Val Gly Ala Ala Thr Ala
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 Gly Ala Phe Ala Leu Leu Arg Lys Lys
 355 360

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 <223> RXA00981

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| Met Ser Glu Asn Leu | |
| 1 5 | |
| cca gcg ccc gag aat ctc ctg gac gcc gag aga att cag atg atc aag | 163 |
| Pro Ala Pro Glu Asn Leu Leu Asp Ala Glu Arg Ile Gln Met Ile Lys | |
| 10 15 20 | |
| aac ttc cgc aac gaa tta acg ggg ttc atg ctc aac tac caa ttt ggc | 211 |
| Asn Phe Arg Asn Glu Leu Thr Gly Phe Met Leu Asn Tyr Gln Phe Gly | |
| 25 30 35 | |
| att gat gag atc ctg acc aag atc aac atc ctg aaa act gaa ttc agc | 259 |
| Ile Asp Glu Ile Leu Thr Lys Ile Asn Ile Leu Lys Thr Glu Phe Ser | |
| 40 45 50 | |
| cag ctg cac gaa tac gca cct atc gag cac gta tct tca cga ttg aag | 307 |
| Gln Leu His Glu Tyr Ala Pro Ile Glu His Val Ser Ser Arg Leu Lys | |
| 55 60 65 | |
| aca cca gaa agc atc gtc aaa aag gtc atc cga aaa gga gac gag ctc | 355 |
| Thr Pro Glu Ser Ile Val Lys Lys Val Ile Arg Lys Gly Asp Glu Leu | |
| 70 75 80 85 | |
| tcc ctc gca gct atc aaa gac aca gtg ttt gat atc gca ggc att cga | 403 |
| Ser Leu Ala Ala Ile Lys Asp Thr Val Phe Asp Ile Ala Gly Ile Arg | |
| 90 95 100 | |
| atc gtc tgc agt ttc ctc aaa gat gcc tac gca atc gcc gat atg ctg | 451 |
| Ile Val Cys Ser Phe Leu Lys Asp Ala Tyr Ala Ile Ala Asp Met Leu | |
| 105 110 115 | |
| acc aac caa aaa gac gtc acg gtc atc gag gcc aaa gac tac atc gct | 499 |
| Thr Asn Gln Lys Asp Val Thr Val Ile Glu Ala Lys Asp Tyr Ile Ala | |
| 120 125 130 | |
| aac cca aag ccg aac ggc tac aag agt ttg cac ctt atc ctc caa gtg | 547 |
| Asn Pro Lys Pro Asn Gly Tyr Lys Ser Leu His Leu Ile Leu Gln Val | |
| 135 140 145 | |
| cct gtc ttc ctg tct aac tcc gtg gaa aag gtc aat gtt gaa gtc cag | 595 |
| Pro Val Phe Leu Ser Asn Ser Val Glu Lys Val Asn Val Glu Val Gln | |
| 150 155 160 165 | |
| atc cgc acc att gcc atg gac ttc tgg gca agc ctc gag cac aaa atc | 643 |
| Ile Arg Thr Ile Ala Met Asp Phe Trp Ala Ser Leu Glu His Lys Ile | |
| 170 175 180 | |
| tac tac aaa ttt gaa caa gaa gtt cct cag tca atc ctt gat gag ctc | 691 |
| Tyr Tyr Lys Phe Glu Gln Glu Val Pro Gln Ser Ile Leu Asp Glu Leu | |
| 185 190 195 | |
| agt gaa gat gga aag aat cca cgg gga agt gaa gtc act taaacctcca | 740 |
| Ser Glu Asp Gly Lys Asn Pro Arg Gly Ser Glu Val Thr | |
| 200 205 210 | |
| gttgaaacca ctg | 753 |

<210> 98
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 <213> Corynebacterium glutamicum

<400> 98

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| Met | Ser | Glu | Asn | Leu | Pro | Ala | Pro | Glu | Asn | Leu | Leu | Asp | Ala | Glu | Arg |
| 1 | | | | 5 | | | | 10 | | | | | 15 | | |
| Ile | Gln | Met | Ile | Lys | Asn | Phe | Arg | Asn | Glu | Leu | Thr | Gly | Phe | Met | Leu |
| | 20 | | | | | | | 25 | | | | | 30 | | |
| Asn | Tyr | Gln | Phe | Gly | Ile | Asp | Glu | Ile | Leu | Thr | Lys | Ile | Asn | Ile | Leu |
| | 35 | | | | | | 40 | | | | | 45 | | | |
| Lys | Thr | Glu | Phe | Ser | Gln | Leu | His | Glu | Tyr | Ala | Pro | Ile | Glu | His | Val |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Ser | Ser | Arg | Leu | Lys | Thr | Pro | Glu | Ser | Ile | Val | Lys | Lys | Val | Ile | Arg |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |
| Lys | Gly | Asp | Glu | Leu | Ser | Leu | Ala | Ala | Ile | Lys | Asp | Thr | Val | Phe | Asp |
| | | | 85 | | | | | | 90 | | | | | 95 | |
| Ile | Ala | Gly | Ile | Arg | Ile | Val | Cys | Ser | Phe | Leu | Lys | Asp | Ala | Tyr | Ala |
| | | 100 | | | | | | 105 | | | | | 110 | | |
| Ile | Ala | Asp | Met | Leu | Thr | Asn | Gln | Lys | Asp | Val | Thr | Val | Ile | Glu | Ala |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Lys | Asp | Tyr | Ile | Ala | Asn | Pro | Lys | Pro | Asn | Gly | Tyr | Lys | Ser | Leu | His |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Leu | Ile | Leu | Gln | Val | Pro | Val | Phe | Leu | Ser | Asn | Ser | Val | Glu | Lys | Val |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |
| Asn | Val | Glu | Val | Gln | Ile | Arg | Thr | Ile | Ala | Met | Asp | Phe | Trp | Ala | Ser |
| | | | 165 | | | | | | 170 | | | | | 175 | |
| Leu | Glu | His | Lys | Ile | Tyr | Tyr | Lys | Phe | Glu | Gln | Glu | Val | Pro | Gln | Ser |
| | | | 180 | | | | | 185 | | | | | 190 | | |
| Ile | Leu | Asp | Glu | Leu | Ser | Glu | Asp | Gly | Lys | Asn | Pro | Arg | Gly | Ser | Glu |
| | | 195 | | | | | 200 | | | | | 205 | | | |
| Val | Thr | | | | | | | | | | | | | | |
| | 210 | | | | | | | | | | | | | | |

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 <212> DNA
 <213> Corynebacterium glutamicum
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 <223> RXN00786

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gtctaggtgt ttagcctcaa cgttggatac gctgggaggc atg agc tca cct gtt 115
                                         Met Ser Ser Pro Val
                                         1                               5

atc agc ccc gaa acc aaa acc gga aag aag atc ctg ctt gca gcc cct 163
Ile Ser Pro Glu Thr Lys Thr Gly Lys Lys Ile Leu Leu Ala Ala Pro
                        10                               15                               20

cgc gga tac tgt gcc ggc gta gac cgt gca gtg gaa acc gtc gag cgc 211
Arg Gly Tyr Cys Ala Gly Val Asp Arg Ala Val Glu Thr Val Glu Arg
                        25                               30                               35

gcg ctc gag gaa tac ggc gcc cca att tat gtc cgt aaa gaa atc gtg 259
Ala Leu Glu Glu Tyr Gly Ala Pro Ile Tyr Val Arg Lys Glu Ile Val
                        40                               45                               50

cac aac cgt tac gtt gtg gac acc ctg gca gaa aag ggc gcg att ttt 307
His Asn Arg Tyr Val Val Asp Thr Leu Ala Glu Lys Gly Ala Ile Phe
                        55                               60                               65

gtc aac gaa gca tct gaa gca cca gaa ggt gcc aac atg gtg ttc tct 355
Val Asn Glu Ala Ser Glu Ala Pro Glu Gly Ala Asn Met Val Phe Ser
                        70                               75                               80                               85

gca cac ggc gtg agc cca atg gtc cac gaa gaa gct gca gct aaa aac 403
Ala His Gly Val Ser Pro Met Val His Glu Glu Ala Ala Ala Lys Asn
                        90                               95                               100

atc aag gct att gac gcg gcc tgc ccg ctg gtc acc aaa gtg cac aag 451
Ile Lys Ala Ile Asp Ala Ala Cys Pro Leu Val Thr Lys Val His Lys
                        105                               110                               115

gaa gtc cag cgc ttt gat aag cag gga ttc cac att ctc ttc atc ggt 499
Glu Val Gln Arg Phe Asp Lys Gln Gly Phe His Ile Leu Phe Ile Gly
                        120                               125                               130

cac gaa ggc cat gaa gaa gta gag ggc acc atg ggt cat tcc gtt gag 547
His Glu Gly His Glu Glu Val Glu Gly Thr Met Gly His Ser Val Glu
                        135                               140                               145

aaa acc cac ctg gtt gac ggc gtt gct ggc att gcc acc ctg cct gaa 595
Lys Thr His Leu Val Asp Gly Val Ala Gly Ile Ala Thr Leu Pro Glu
                        150                               155                               160                               165

ttc tta aac gat gaa cca aac ctg atc tgg ctg tct cag acc acg ctt 643
Phe Leu Asn Asp Glu Pro Asn Leu Ile Trp Leu Ser Gln Thr Thr Leu
                        170                               175                               180

tct gtg gac gag acc atg gag atc gtc cgc gag ctg aag gtg aag ttc 691
Ser Val Asp Glu Thr Met Glu Ile Val Arg Glu Leu Lys Val Lys Phe

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| 185 | 190 | 195 | |
|---|-----|-----|------|
| cct cag ctg cag gat cca ccg tca gat gat att tgc tac gcc acg cag | | | 739 |
| Pro Gln Leu Gln Asp Pro Pro Ser Asp Asp Ile Cys Tyr Ala Thr Gln | | | |
| 200 | 205 | 210 | |
| aac cgc cag gtt gcc gtc aag gct atc gct gag cgc tgc gag ctg atg | | | 787 |
| Asn Arg Gln Val Ala Val Lys Ala Ile Ala Glu Arg Cys Glu Leu Met | | | |
| 215 | 220 | 225 | |
| att gtg gtc ggt tcc cgc aac tcc tcc aac tgc gtt cgt ctg gtt gag | | | 835 |
| Ile Val Val Gly Ser Arg Asn Ser Ser Asn Ser Val Arg Leu Val Glu | | | |
| 230 | 235 | 240 | 245 |
| gtc gct aag caa aac ggt gcc gat aac gcc tac ctg gtg gat tac gcc | | | 883 |
| Val Ala Lys Gln Asn Gly Ala Asp Asn Ala Tyr Leu Val Asp Tyr Ala | | | |
| 250 | 255 | 260 | |
| cgc gaa atc gac cca gca tgg ttc gaa ggc gta gag acc atc ggt atc | | | 931 |
| Arg Glu Ile Asp Pro Ala Trp Phe Glu Gly Val Glu Thr Ile Gly Ile | | | |
| 265 | 270 | 275 | |
| tcc tcc ggc gct tcc gtg cct gag atc ctc gtc cag ggc gtc att gag | | | 979 |
| Ser Ser Gly Ala Ser Val Pro Glu Ile Leu Val Gln Gly Val Ile Glu | | | |
| 280 | 285 | 290 | |
| cgc ctg gct gag ttc ggc tac gac gac gtc gag gaa gtc acc tcc gcc | | | 1027 |
| Arg Leu Ala Glu Phe Gly Tyr Asp Asp Val Glu Glu Val Thr Ser Ala | | | |
| 295 | 300 | 305 | |
| gct gag aag att gtt ttc gcg ctg cct cgc gtg ctg cgc cac aag aat | | | 1075 |
| Ala Glu Lys Ile Val Phe Ala Leu Pro Arg Val Leu Arg His Lys Asn | | | |
| 310 | 315 | 320 | 325 |
| taattgcaag aatgaaaaat ccc | | | 1098 |

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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 100
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 Glu Thr Val Glu Arg Ala Leu Glu Glu Tyr Gly Ala Pro Ile Tyr Val
 35 40 45
 Arg Lys Glu Ile Val His Asn Arg Tyr Val Val Asp Thr Leu Ala Glu
 50 55 60
 Lys Gly Ala Ile Phe Val Asn Glu Ala Ser Glu Ala Pro Glu Gly Ala
 65 70 75 80

Asn Met Val Phe Ser Ala His Gly Val Ser Pro Met Val His Glu Glu
 85 90 95
 Ala Ala Ala Lys Asn Ile Lys Ala Ile Asp Ala Ala Cys Pro Leu Val
 100 105 110
 Thr Lys Val His Lys Glu Val Gln Arg Phe Asp Lys Gln Gly Phe His
 115 120 125
 Ile Leu Phe Ile Gly His Glu Gly His Glu Glu Val Glu Gly Thr Met
 130 135 140
 Gly His Ser Val Glu Lys Thr His Leu Val Asp Gly Val Ala Gly Ile
 145 150 155 160
 Ala Thr Leu Pro Glu Phe Leu Asn Asp Glu Pro Asn Leu Ile Trp Leu
 165 170 175
 Ser Gln Thr Thr Leu Ser Val Asp Glu Thr Met Glu Ile Val Arg Glu
 180 185 190
 Leu Lys Val Lys Phe Pro Gln Leu Gln Asp Pro Pro Ser Asp Asp Ile
 195 200 205
 Cys Tyr Ala Thr Gln Asn Arg Gln Val Ala Val Lys Ala Ile Ala Glu
 210 215 220
 Arg Cys Glu Leu Met Ile Val Val Gly Ser Arg Asn Ser Ser Asn Ser
 225 230 235 240
 Val Arg Leu Val Glu Val Ala Lys Gln Asn Gly Ala Asp Asn Ala Tyr
 245 250 255
 Leu Val Asp Tyr Ala Arg Glu Ile Asp Pro Ala Trp Phe Glu Gly Val
 260 265 270
 Glu Thr Ile Gly Ile Ser Ser Gly Ala Ser Val Pro Glu Ile Leu Val
 275 280 285
 Gln Gly Val Ile Glu Arg Leu Ala Glu Phe Gly Tyr Asp Asp Val Glu
 290 295 300
 Glu Val Thr Ser Ala Ala Glu Lys Ile Val Phe Ala Leu Pro Arg Val
 305 310 315 320
 Leu Arg His Lys Asn
 325

<210> 101
 <211> 1131
 <212> DNA
 <213> Corynebacterium glutamicum

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 <221> CDS

<222> (101)..(1108)

<223> RXS01027

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 Met Ala Asn Lys Asn
 1 5

aat aag cct cat gag gtg gac aaa gac caa gat tca gcc atg ctg atc 163
 Asn Lys Pro His Glu Val Asp Lys Asp Gln Asp Ser Ala Met Leu Ile
 10 15 20

aac ggt cgc ctg caa cag atc ccg gcg cgt ccc act gag gaa ttc acc 211
 Asn Gly Arg Leu Gln Gln Ile Pro Ala Arg Pro Thr Glu Glu Phe Thr
 25 30 35

cgc cca act ctt gca gca ggt gca gta ctg tgg cgc ggc gac atc acc 259
 Arg Pro Thr Leu Ala Ala Gly Ala Val Leu Trp Arg Gly Asp Ile Thr
 40 45 50

aac ccg gac agc atc gag gtc gct gtc atc cac cgc ccg cac tat gat 307
 Asn Pro Asp Ser Ile Glu Val Ala Val Ile His Arg Pro His Tyr Asp
 55 60 65

gac tgg tcc ctg gcc aag ggc aaa gtc gat ccc ggc gag tct att ccg 355
 Asp Trp Ser Leu Ala Lys Gly Lys Val Asp Pro Gly Glu Ser Ile Pro
 70 75 80 85

aca acc gcg gcc cgt gaa atc ctt gaa gaa act ggc tac gac atc cgt 403
 Thr Thr Ala Ala Arg Glu Ile Leu Glu Glu Thr Gly Tyr Asp Ile Arg
 90 95 100

ctg ggc aag ctg atc ggc aag gtt act tac cct gtg ctc gac cga acc 451
 Leu Gly Lys Leu Ile Gly Lys Val Thr Tyr Pro Val Leu Asp Arg Thr
 105 110 115

aaa gtg gtc tac tac tgg act gcc cag gtt ctt ggt gga gag ttt gtc 499
 Lys Val Val Tyr Tyr Trp Thr Ala Gln Val Leu Gly Gly Glu Phe Val
 120 125 130

ccc aac gat gaa gtt gat gaa atc cgt tgg ctg tct gtt gat gaa gca 547
 Pro Asn Asp Glu Val Asp Glu Ile Arg Trp Leu Ser Val Asp Glu Ala
 135 140 145

tgc gag ttg ctc agc tac caa gta gat acc gaa gtt ctg gcc aag gca 595
 Cys Glu Leu Leu Ser Tyr Gln Val Asp Thr Glu Val Leu Ala Lys Ala
 150 155 160 165

gca aag cgt ttc cgc act cct tcc acc act cgg gtg ctg tat gtt cgc 643
 Ala Lys Arg Phe Arg Thr Pro Ser Thr Thr Arg Val Leu Tyr Val Arg
 170 175 180

cat gct cat gca cat ggt cgc caa acc tgg ggt ggc gac gac aat aag 691
 His Ala His Ala His Gly Arg Gln Thr Trp Gly Gly Asp Asp Asn Lys
 185 190 195

cgc cca ttg gac aaa aag ggg cgt cga caa gca gaa atg ctc gta ccc 739
 Arg Pro Leu Asp Lys Lys Gly Arg Arg Gln Ala Glu Met Leu Val Pro
 200 205 210

atg ttg ttg ccc ttc aaa ccc acc gca att tac tcg gcg gtg ccc gat 787
 Met Leu Leu Pro Phe Lys Pro Thr Ala Ile Tyr Ser Ala Val Pro Asp
 215 220 225

cgc tgc caa gcc acc gcg ctc ccc ctt gcc gat gag ctc ggc ctc gac 835
 Arg Cys Gln Ala Thr Ala Leu Pro Leu Ala Asp Glu Leu Gly Leu Asp
 230 235 240 245

gtg tcc gtc aac cga ctg ttc ggc gac gac gcc tgg gaa acc gat ccc 883
 Val Ser Val Asn Arg Leu Phe Gly Asp Asp Ala Trp Glu Thr Asp Pro
 250 255 260

gag gcc tgc aag aag cgc ttc acc gac gtg gtc gcg caa ggt ggc gtg 931
 Glu Ala Cys Lys Lys Arg Phe Thr Asp Val Val Ala Gln Gly Gly Val
 265 270 275

ccg atg atc gtt ggg cag ggc gac atc att ccg gaa atg atc aaa tgg 979
 Pro Met Ile Val Gly Gln Gly Asp Ile Ile Pro Glu Met Ile Lys Trp
 280 285 290

ttc tcc gag aac ggc acc ctc cct atc gat gag aag atc aag gcg aaa 1027
 Phe Ser Glu Asn Gly Thr Leu Pro Ile Asp Glu Lys Ile Lys Ala Lys
 295 300 305

aag ggc agc gtg tgg gtg ttg agc ttt cac gac ggt gtg ttc acc ggc 1075
 Lys Gly Ser Val Trp Val Leu Ser Phe His Asp Gly Val Phe Thr Gly
 310 315 320 325

gct gat tac ctg gcg agt tcc ctg ccg gtt aaa taggagcgcg tttaaggcct 1128
 Ala Asp Tyr Leu Ala Ser Ser Leu Pro Val Lys
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Thr Glu Glu Phe Thr Arg Pro Thr Leu Ala Ala Gly Ala Val Leu Trp
 35 40 45

Arg Gly Asp Ile Thr Asn Pro Asp Ser Ile Glu Val Ala Val Ile His
 50 55 60

Arg Pro His Tyr Asp Asp Trp Ser Leu Ala Lys Gly Lys Val Asp Pro
 65 70 75 80
 Gly Glu Ser Ile Pro Thr Thr Ala Ala Arg Glu Ile Leu Glu Glu Thr
 85 90 95
 Gly Tyr Asp Ile Arg Leu Gly Lys Leu Ile Gly Lys Val Thr Tyr Pro
 100 105 110
 Val Leu Asp Arg Thr Lys Val Val Tyr Tyr Trp Thr Ala Gln Val Leu
 115 120 125
 Gly Gly Glu Phe Val Pro Asn Asp Glu Val Asp Glu Ile Arg Trp Leu
 130 135 140
 Ser Val Asp Glu Ala Cys Glu Leu Leu Ser Tyr Gln Val Asp Thr Glu
 145 150 155 160
 Val Leu Ala Lys Ala Ala Lys Arg Phe Arg Thr Pro Ser Thr Thr Arg
 165 170 175
 Val Leu Tyr Val Arg His Ala His Ala His Gly Arg Gln Thr Trp Gly
 180 185 190
 Gly Asp Asp Asn Lys Arg Pro Leu Asp Lys Lys Gly Arg Arg Gln Ala
 195 200 205
 Glu Met Leu Val Pro Met Leu Leu Pro Phe Lys Pro Thr Ala Ile Tyr
 210 215 220
 Ser Ala Val Pro Asp Arg Cys Gln Ala Thr Ala Leu Pro Leu Ala Asp
 225 230 235 240
 Glu Leu Gly Leu Asp Val Ser Val Asn Arg Leu Phe Gly Asp Asp Ala
 245 250 255
 Trp Glu Thr Asp Pro Glu Ala Cys Lys Lys Arg Phe Thr Asp Val Val
 260 265 270
 Ala Gln Gly Gly Val Pro Met Ile Val Gly Gln Gly Asp Ile Ile Pro
 275 280 285
 Glu Met Ile Lys Trp Phe Ser Glu Asn Gly Thr Leu Pro Ile Asp Glu
 290 295 300
 Lys Ile Lys Ala Lys Lys Gly Ser Val Trp Val Leu Ser Phe His Asp
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 Gly Val Phe Thr Gly Ala Asp Tyr Leu Ala Ser Ser Leu Pro Val Lys
 325 330 335

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gggtcgtagg tctccaacca ggaggcgttc caacacgagg gtg aat cag gcg tgg 115
 Val Asn Gln Ala Trp
 1 5

cag cag tcc cgt ttg gtt act tct gat gag act tcc gca ggt ggt ctc 163
 Gln Gln Ser Arg Leu Val Thr Ser Asp Glu Thr Ser Ala Gly Gly Leu
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gtg gtg tca ggt ttg gct gag gcg gtc aac gct aac aat gag gtt gat 211
 Val Val Ser Gly Leu Ala Glu Ala Val Asn Ala Asn Asn Glu Val Asp
 25 30 35

ctg tcg aag att tat gtt gcg ttg att ggt cgc ctt gat cgt cgt ggt 259
 Leu Ser Lys Ile Tyr Val Ala Leu Ile Gly Arg Leu Asp Arg Arg Gly
 40 45 50

cgt ttg ttg tgg tcg atg ccg aag ggc cat gtt gag cct ggt gag gat 307
 Arg Leu Leu Trp Ser Met Pro Lys Gly His Val Glu Pro Gly Glu Asp
 55 60 65

aag gct gcg act gct gag cgt gag gtg tgg gag gag acc ggc atc cac 355
 Lys Ala Ala Thr Ala Glu Arg Glu Val Trp Glu Glu Thr Gly Ile His
 70 75 80 85

ggt gag gtg ttc act gag ttg ggt gtg att gat tat tgg ttc gtt tcg 403
 Gly Glu Val Phe Thr Glu Leu Gly Val Ile Asp Tyr Trp Phe Val Ser
 90 95 100

gaa ggg aag cgg atc cat aag acg gtg cat cat cat ttg ttg cgt tat 451
 Glu Gly Lys Arg Ile His Lys Thr Val His His His Leu Leu Arg Tyr
 105 110 115

gtt gat ggc gat ttg aat gat gag gat cca gaa gtc act gag gtg gcg 499
 Val Asp Gly Asp Leu Asn Asp Glu Asp Pro Glu Val Thr Glu Val Ala
 120 125 130

tgg att ccg gcg aat cag ttg att gag cat ttg gct ttt gcg gat gag 547
 Trp Ile Pro Ala Asn Gln Leu Ile Glu His Leu Ala Phe Ala Asp Glu
 135 140 145

cgg aag ttg gct agg cag gcg cat gat ttg ttg cct gag ttt gct ttg 595
 Arg Lys Leu Ala Arg Gln Ala His Asp Leu Leu Pro Glu Phe Ala Leu
 150 155 160 165

aag gaa aag gcg gag gga agg tcc acc cca agg tgattccgaa ccccaaccg 648

Lys Glu Lys Ala Glu Gly Arg Ser Thr Pro Arg
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651

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Asn Asn Glu Val Asp Leu Ser Lys Ile Tyr Val Ala Leu Ile Gly Arg
35 40 45

Leu Asp Arg Arg Gly Arg Leu Leu Trp Ser Met Pro Lys Gly His Val
50 55 60

Glu Pro Gly Glu Asp Lys Ala Ala Thr Ala Glu Arg Glu Val Trp Glu
65 70 75 80

Glu Thr Gly Ile His Gly Glu Val Phe Thr Glu Leu Gly Val Ile Asp
85 90 95

Tyr Trp Phe Val Ser Glu Gly Lys Arg Ile His Lys Thr Val His His
100 105 110

His Leu Leu Arg Tyr Val Asp Gly Asp Leu Asn Asp Glu Asp Pro Glu
115 120 125

Val Thr Glu Val Ala Trp Ile Pro Ala Asn Gln Leu Ile Glu His Leu
130 135 140

Ala Phe Ala Asp Glu Arg Lys Leu Ala Arg Gln Ala His Asp Leu Leu
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Pro Glu Phe Ala Leu Lys Glu Lys Ala Glu Gly Arg Ser Thr Pro Arg
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| 1 5 10 15 | |
| ggt cgc ctg ggc aaa ggc gtc gac gcc acc ggt cag cta gac ccc gag | 96 |
| Val Arg Leu Gly Lys Gly Val Asp Ala Thr Gly Gln Leu Asp Pro Glu | |
| 20 25 30 | |
| gca atc gag cgc act cgt gtc gct ttg gaa aac tac gtt gaa ctc atg | 144 |
| Ala Ile Glu Arg Thr Arg Val Ala Leu Glu Asn Tyr Val Glu Leu Met | |
| 35 40 45 | |
| gaa acc cat ggg gta gag gcc gta cga atg gtt gcc acc tcc gca acc | 192 |
| Glu Thr His Gly Val Glu Ala Val Arg Met Val Ala Thr Ser Ala Thr | |
| 50 55 60 | |
| cgc gat gcg tcc aac cgc gat gaa ttc ttt tcg atg acc cgc cag ctt | 240 |
| Arg Asp Ala Ser Asn Arg Asp Glu Phe Phe Ser Met Thr Arg Gln Leu | |
| 65 70 75 80 | |
| ctg tcc aag atc cgt cct gga tac caa gct gaa gta att tcc ggc gaa | 288 |
| Leu Ser Lys Ile Arg Pro Gly Tyr Gln Ala Glu Val Ile Ser Gly Glu | |
| 85 90 95 | |
| gag gaa gct ctg ctg tcc ttc cga ggt gca atc gtt gac ctg cct gaa | 336 |
| Glu Glu Ala Leu Leu Ser Phe Arg Gly Ala Ile Val Asp Leu Pro Glu | |
| 100 105 110 | |
| gac caa ggt cct ttc tgt gtt atc gac ctt ggc ggt gga tcc act gag | 384 |
| Asp Gln Gly Pro Phe Cys Val Ile Asp Leu Gly Gly Gly Ser Thr Glu | |
| 115 120 125 | |
| ttc atc gtt ggc acc tac gac ggt gaa atc cta ggc tcc cac tca acc | 432 |
| Phe Ile Val Gly Thr Tyr Asp Gly Glu Ile Leu Gly Ser His Ser Thr | |
| 130 135 140 | |
| caa atg gga tgc gtg cgc ctg acc gaa cga atc atg cgc agc gac cca | 480 |
| Gln Met Gly Cys Val Arg Leu Thr Glu Arg Ile Met Arg Ser Asp Pro | |
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| Pro Asp | |

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<211> 162

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<400> 106

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 Pro Glu Glu Tyr Asn Ser Ala Gln Leu Glu Ala Asp Phe Gly Pro Arg
 55 60 65
 gtg cgc gag ttg gtg gaa gag ctc acc aaa cag ccc tta aaa agc tgg 355
 Val Arg Glu Leu Val Glu Glu Leu Thr Lys Gln Pro Leu Lys Ser Trp
 70 75 80 85
 aaa gcg cgt gcc gac gct tac ctc ctg cac ctc agc gca ggt gcc agc 403
 Lys Ala Arg Ala Asp Ala Tyr Leu Leu His Leu Ser Ala Gly Ala Ser
 90 95 100
 tta gag gct gtc tta atc tcc acc gca gat aaa ctg cat aat ctc atg 451
 Leu Glu Ala Val Leu Ile Ser Thr Ala Asp Lys Leu His Asn Leu Met
 105 110 115
 tcc atc ttg gat gac ctt gaa ata cac ggt gaa gat tta tgg caa cgc 499
 Ser Ile Leu Asp Asp Leu Glu Ile His Gly Glu Asp Leu Trp Gln Arg
 120 125 130
 ttt aac gct ggc aaa gag cag caa atc tgg tgg tat agc gag gtt tat 547
 Phe Asn Ala Gly Lys Glu Gln Gln Ile Trp Trp Tyr Ser Glu Val Tyr
 135 140 145
 cag ata tct ctc cag cgc tta ggg ttc aat gag ttg aat aaa caa ctg 595
 Gln Ile Ser Leu Gln Arg Leu Gly Phe Asn Glu Leu Asn Lys Gln Leu
 150 155 160 165
 ggg ttg tgc gtc gaa aag ctc tta aag caa agc gcc taggcgctcg 641
 Gly Leu Cys Val Glu Lys Leu Leu Lys Gln Ser Ala
 170 175
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 Ser Val Thr Asn Asp Glu Asp Val Leu Ile Ala Gly Leu Leu His Asp
 35 40 45
 Thr Leu Glu Asp Val Pro Glu Glu Tyr Asn Ser Ala Gln Leu Glu Ala
 50 55 60
 Asp Phe Gly Pro Arg Val Arg Glu Leu Val Glu Glu Leu Thr Lys Gln

Ala

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| gattcacact | | | | | | | | | | | | | | | | 115 |
| ttgccaccct | | | | | | | | | | | | | | | | |
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| ggt | | | | | | | | | | | | | | | | 5 |
| gta | | | | | | | | | | | | | | | | |
| Val | | | | | | | | | | | | | | | | |
| Arg | | | | | | | | | | | | | | | | |
| Leu | | | | | | | | | | | | | | | | |
| Gly | | | | | | | | | | | | | | | | |
| Val | | | | | | | | | | | | | | | | |
| 115 | | | | | | | | | | | | | | | | |
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| gat | | | | | | | | | | | | | | | | |
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| ggc | | | | | | | | | | | | | | | | |
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| aat | | | | | | | | | | | | | | | | |
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| gcg | | | | | | | | | | | | | | | | |
| cgt | | | | | | | | | | | | | | | | |
| 163 | | | | | | | | | | | | | | | | |
| Leu | | | | | | | | | | | | | | | | |
| Asp | | | | | | | | | | | | | | | | |
| Val | | | | | | | | | | | | | | | | |
| Gly | | | | | | | | | | | | | | | | |
| Ser | | | | | | | | | | | | | | | | |
| Asn | | | | | | | | | | | | | | | | |
| Thr | | | | | | | | | | | | | | | | |
| Val | | | | | | | | | | | | | | | | |
| His | | | | | | | | | | | | | | | | |
| Leu | | | | | | | | | | | | | | | | |
| Val | | | | | | | | | | | | | | | | |
| Ala | | | | | | | | | | | | | | | | |
| Val | | | | | | | | | | | | | | | | |
| Asp | | | | | | | | | | | | | | | | |
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| cac | | | | | | | | | | | | | | | | |
| ccc | | | | | | | | | | | | | | | | |
| acc | | | | | | | | | | | | | | | | |
| ccg | | | | | | | | | | | | | | | | |
| atg | | | | | | | | | | | | | | | | |
| agc | | | | | | | | | | | | | | | | |
| aat | | | | | | | | | | | | | | | | |
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| cgt | | | | | | | | | | | | | | | | |
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| ctg | | | | | | | | | | | | | | | | |
| cgc | | | | | | | | | | | | | | | | |
| 211 | | | | | | | | | | | | | | | | |
| Pro | | | | | | | | | | | | | | | | |
| Gly | | | | | | | | | | | | | | | | |
| Gly | | | | | | | | | | | | | | | | |
| His | | | | | | | | | | | | | | | | |
| Pro | | | | | | | | | | | | | | | | |
| Thr | | | | | | | | | | | | | | | | |
| Pro | | | | | | | | | | | | | | | | |
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| Asn | | | | | | | | | | | | | | | | |
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| Thr | | | | | | | | | | | | | | | | |
| Pro | | | | | | | | | | | | | | | | |
| Leu | | | | | | | | | | | | | | | | |
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| Val | | | | | | | | | | | | | | | | |
| Glu | | | | | | | | | | | | | | | | |
| Leu | | | | | | | | | | | | | | | | |
| Leu | | | | | | | | | | | | | | | | |
| Asp | | | | | | | | | | | | | | | | |
| Asp | | | | | | | | | | | | | | | | |
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| Gly | | | | | | | | | | | | | | | | |
| Ala | | | | | | | | | | | | | | | | |
| Ile | | | | | | | | | | | | | | | | |
| Ser | | | | | | | | | | | | | | | | |
| Glu | | | | | | | | | | | | | | | | |
| Lys | | | | | | | | | | | | | | | | |
| Gly | | | | | | | | | | | | | | | | |
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| 307 | | | | | | | | | | | | | | | | |
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| Lys | | | | | | | | | | | | | | | | |
| Leu | | | | | | | | | | | | | | | | |
| Thr | | | | | | | | | | | | | | | | |
| Ser | | | | | | | | | | | | | | | | |
| Ala | | | | | | | | | | | | | | | | |
| Val | | | | | | | | | | | | | | | | |
| Gly | | | | | | | | | | | | | | | | |
| Glu | | | | | | | | | | | | | | | | |
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| Ala | | | | | | | | | | | | | | | | |
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| Leu Gly Cys Ala Glu Leu Met Pro Phe Ala Thr Ser Ala Val Arg Ser | |
| 70 75 80 85 | |
| gcc acc aac agc gag gca gtg ctc gac cac gtg gag aag gaa acc ggc | 403 |
| Ala Thr Asn Ser Glu Ala Val Leu Asp His Val Glu Lys Glu Thr Gly | |
| 90 95 100 | |
| gtc cgc ctg tcc atc ctt tcc ggt gaa gac gaa gca cgc caa act ttc | 451 |
| Val Arg Leu Ser Ile Leu Ser Gly Glu Asp Glu Ala Arg Gln Thr Phe | |
| 105 110 115 | |
| ctc gca gtt cga cgt tgg tat gga tgg tcc gca ggg cgc ata act aac | 499 |
| Leu Ala Val Arg Arg Trp Tyr Gly Trp Ser Ala Gly Arg Ile Thr Asn | |
| 120 125 130 | |
| ctc gac atc ggt ggc ggc tcc ctg gaa cta tcc tcc gga acc gac gaa | 547 |
| Leu Asp Ile Gly Gly Gly Ser Leu Glu Leu Ser Ser Gly Thr Asp Glu | |
| 135 140 145 | |
| tcc cca gac ctc gcg ttc tca ctg gat ctg ggt gcg ggc cgc ttg acc | 595 |
| Ser Pro Asp Leu Ala Phe Ser Leu Asp Leu Gly Ala Gly Arg Leu Thr | |
| 150 155 160 165 | |
| cac aac tgg ttc gac acc gat cca ccg gca cgt aag aaa atc aac ctc | 643 |
| His Asn Trp Phe Asp Thr Asp Pro Pro Ala Arg Lys Lys Ile Asn Leu | |
| 170 175 180 | |
| ctg cgc gat tat atc gat gcg gaa ctt gca gaa ccc gcc cgc cag atg | 691 |
| Leu Arg Asp Tyr Ile Asp Ala Glu Leu Ala Glu Pro Ala Arg Gln Met | |
| 185 190 195 | |
| cgc acc cta ggg ccc gcg cgc ctg gca gtg gga aca tcc aaa act ttc | 739 |
| Arg Thr Leu Gly Pro Ala Arg Leu Ala Val Gly Thr Ser Lys Thr Phe | |
| 200 205 210 | |
| cgc acc ctg gca cga ctg act ggt gct gcg ccc tca tcc gca gga cca | 787 |
| Arg Thr Leu Ala Arg Leu Thr Gly Ala Ala Pro Ser Ser Ala Gly Pro | |
| 215 220 225 | |
| cac gtc acc cga acc ctc acc gcg ccg ggt ctg cgc cag ctg atc gca | 835 |
| His Val Thr Arg Thr Leu Thr Ala Pro Gly Leu Arg Gln Leu Ile Ala | |
| 230 235 240 245 | |
| ttt atc tca cga atg act gcg gcg gac cgc gct gag ctg gaa ggt atc | 883 |
| Phe Ile Ser Arg Met Thr Ala Ala Asp Arg Ala Glu Leu Glu Gly Ile | |
| 250 255 260 | |
| agc tcg gat cgg tca cat cag atc gtg gca ggt gcg cta gtt gcg gaa | 931 |
| Ser Ser Asp Arg Ser His Gln Ile Val Ala Gly Ala Leu Val Ala Glu | |
| 265 270 275 | |
| gct gcg atg cgt gcg ttg gat att gac aag gta gaa att tgt ccg tgg | 979 |
| Ala Ala Met Arg Ala Leu Asp Ile Asp Lys Val Glu Ile Cys Pro Trp | |
| 280 285 290 | |
| gca ctt cgt gaa ggt gtg atc ctc acc agg atc gac aaa gga ctc gag | 1027 |

Ala Leu Arg Glu Gly Val Ile Leu Thr Arg Ile Asp Lys Gly Leu Glu
 295 300 305

taacatttac ccggaaagga gtt

1050

<210> 110

<211> 309

<212> PRT

<213> Corynebacterium glutamicum

<400> 110

Val Arg Leu Gly Val Leu Asp Val Gly Ser Asn Thr Val His Leu Val
 1 5 10 15

Ala Val Asp Ala Arg Pro Gly Gly His Pro Thr Pro Met Ser Asn Trp
 20 25 30

Arg Thr Pro Leu Arg Leu Val Glu Leu Leu Asp Asp Ser Gly Ala Ile
 35 40 45

Ser Glu Lys Gly Ile Asn Lys Leu Thr Ser Ala Val Gly Glu Ala Ala
 50 55 60

Asp Leu Ala Lys Thr Leu Gly Cys Ala Glu Leu Met Pro Phe Ala Thr
 65 70 75 80

Ser Ala Val Arg Ser Ala Thr Asn Ser Glu Ala Val Leu Asp His Val
 85 90 95

Glu Lys Glu Thr Gly Val Arg Leu Ser Ile Leu Ser Gly Glu Asp Glu
 100 105 110

Ala Arg Gln Thr Phe Leu Ala Val Arg Arg Trp Tyr Gly Trp Ser Ala
 115 120 125

Gly Arg Ile Thr Asn Leu Asp Ile Gly Gly Gly Ser Leu Glu Leu Ser
 130 135 140

Ser Gly Thr Asp Glu Ser Pro Asp Leu Ala Phe Ser Leu Asp Leu Gly
 145 150 155 160

Ala Gly Arg Leu Thr His Asn Trp Phe Asp Thr Asp Pro Pro Ala Arg
 165 170 175

Lys Lys Ile Asn Leu Leu Arg Asp Tyr Ile Asp Ala Glu Leu Ala Glu
 180 185 190

Pro Ala Arg Gln Met Arg Thr Leu Gly Pro Ala Arg Leu Ala Val Gly
 195 200 205

Thr Ser Lys Thr Phe Arg Thr Leu Ala Arg Leu Thr Gly Ala Ala Pro
 210 215 220

Ser Ser Ala Gly Pro His Val Thr Arg Thr Leu Thr Ala Pro Gly Leu
 225 230 235 240

Arg Gln Leu Ile Ala Phe Ile Ser Arg Met Thr Ala Ala Asp Arg Ala
 245 250 255

Glu Leu Glu Gly Ile Ser Ser Asp Arg Ser His Gln Ile Val Ala Gly
 260 265 270

Ala Leu Val Ala Glu Ala Ala Met Arg Ala Leu Asp Ile Asp Lys Val
 275 280 285

Glu Ile Cys Pro Trp Ala Leu Arg Glu Gly Val Ile Leu Thr Arg Ile
 290 295 300

Asp Lys Gly Leu Glu
 305

<210> 111
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 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <223> RXS02972

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gaacgaatca tgcgcagcga cccacccgac tgaaaccgaa gtg gaa atc gcc cgc 115
 Val Glu Ile Ala Arg
 1 5

gac tac gtt gca gaa cgc atc cag gaa gta aaa gcc atc gtc cca att 163
 Asp Tyr Val Ala Glu Arg Ile Gln Glu Val Lys Ala Ile Val Pro Ile
 10 15 20

tca aag gca aaa acc ttt gtg gga tgc gca ggc acc ttc acc aca atc 211
 Ser Lys Ala Lys Thr Phe Val Gly Cys Ala Gly Thr Phe Thr Thr Ile
 25 30 35

tcc gcc tgg gtg caa ggc cta gaa agc tac gac cgc gac gcg atc cac 259
 Ser Ala Trp Val Gln Gly Leu Glu Ser Tyr Asp Arg Asp Ala Ile His
 40 45 50

ctc tct gca ctc aac ttc gat gca ctg cga gtt gtc acc gat gag atc 307
 Leu Ser Ala Leu Asn Phe Asp Ala Leu Arg Val Val Thr Asp Glu Ile
 55 60 65

att tca gaa tca tca tca cag cgc gcc agc aac cca gtt gtt gat cca 355
 Ile Ser Glu Ser Ser Ser Gln Arg Ala Ser Asn Pro Val Val Asp Pro
 70 75 80 85

ggg cgc gcc gac gtc atc ggt ggc gga tcc gtt gtt gtc caa gca gcg 403
 Gly Arg Ala Asp Val Ile Gly Gly Gly Ser Val Val Val Gln Ala Ala
 90 95 100

atc gac tta gcc tcc aaa gaa gcc ggt gta gac tac atc att att tcc 451
 Ile Asp Leu Ala Ser Lys Glu Ala Gly Val Asp Tyr Ile Ile Ile Ser
 105 110 115

gaa aaa gac atc ctc gac ggc ctc atc ctt ggc ctg gta gaa gcc gac 499
 Glu Lys Asp Ile Leu Asp Gly Leu Ile Leu Gly Leu Val Glu Ala Asp
 120 125 130

tct ttg aag aaa taggacccta gttttaaac act 534
 Ser Leu Lys Lys
 135

<210> 112
 <211> 137
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 112
 Val Glu Ile Ala Arg Asp Tyr Val Ala Glu Arg Ile Gln Glu Val Lys
 1 5 10 15

Ala Ile Val Pro Ile Ser Lys Ala Lys Thr Phe Val Gly Cys Ala Gly
 20 25 30

Thr Phe Thr Thr Ile Ser Ala Trp Val Gln Gly Leu Glu Ser Tyr Asp
 35 40 45

Arg Asp Ala Ile His Leu Ser Ala Leu Asn Phe Asp Ala Leu Arg Val
 50 55 60

Val Thr Asp Glu Ile Ile Ser Glu Ser Ser Ser Gln Arg Ala Ser Asn
 65 70 75 80

Pro Val Val Asp Pro Gly Arg Ala Asp Val Ile Gly Gly Gly Ser Val
 85 90 95

Val Val Gln Ala Ala Ile Asp Leu Ala Ser Lys Glu Ala Gly Val Asp
 100 105 110

Tyr Ile Ile Ile Ser Glu Lys Asp Ile Leu Asp Gly Leu Ile Leu Gly
 115 120 125

Leu Val Glu Ala Asp Ser Leu Lys Lys
 130 135

<210> 113
 <211> 636
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(613)
 <223> RXA02159

<400> 113

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actgctggtg tggctgctgg ccaaccagcc gaggtaagac atg tcc ctt ggc tca 115
 Met Ser Leu Gly Ser
 1 5

acc ccg tca aca ccg gaa aac tta aat ccc gtg act cgc act gca cgc 163
 Thr Pro Ser Thr Pro Glu Asn Leu Asn Pro Val Thr Arg Thr Ala Arg
 10 15 20

caa gct ctc att ttg cag att ttg gac aaa caa aaa gtc acc agc cag 211
 Gln Ala Leu Ile Leu Gln Ile Leu Asp Lys Gln Lys Val Thr Ser Gln
 25 30 35

gta caa ctg tct gaa ttg ctg ctg gat gaa ggc atc gat atc acc cag 259
 Val Gln Leu Ser Glu Leu Leu Leu Asp Glu Gly Ile Asp Ile Thr Gln
 40 45 50

gcc acc ttg tcc cga gat ctc gat gaa ctc ggt gca cgc aag gtt cgc 307
 Ala Thr Leu Ser Arg Asp Leu Asp Glu Leu Gly Ala Arg Lys Val Arg
 55 60 65

ccc gat ggg gga cgc gcc tac tac gcg gtc ggc cca gta gat agc atc 355
 Pro Asp Gly Gly Arg Ala Tyr Tyr Ala Val Gly Pro Val Asp Ser Ile
 70 75 80 85

gcc cgc gaa gat ctc cgg ggt ccg tcg gag aag ctg cgc cgc atg ctt 403
 Ala Arg Glu Asp Leu Arg Gly Pro Ser Glu Lys Leu Arg Arg Met Leu
 90 95 100

gat gaa ctg ctg gtt tct aca gat cat tcc ggc aac atc gcg atg ctg 451
 Asp Glu Leu Leu Val Ser Thr Asp His Ser Gly Asn Ile Ala Met Leu
 105 110 115

cgc acc ccg ccg gga gct gcc cag tac ctg gca agt ttc atc gat agg 499
 Arg Thr Pro Pro Gly Ala Ala Gln Tyr Leu Ala Ser Phe Ile Asp Arg
 120 125 130

gtg ggg ctg aaa gaa gtc gtt ggc acc atc gct ggt gat gac acc gtt 547
 Val Gly Leu Lys Glu Val Val Gly Thr Ile Ala Gly Asp Asp Thr Val
 135 140 145

ttc gtt ctc gcc cgt gat ccg ctc aca ggt aaa gaa cta ggt gaa tta 595
 Phe Val Leu Ala Arg Asp Pro Leu Thr Gly Lys Glu Leu Gly Glu Leu
 150 155 160 165

ctc agc ggg cgc acc act taaagcgccc ctagttcaag gct 636
 Leu Ser Gly Arg Thr Thr
 170

<210> 114

<211> 171

<212> PRT

<213> Corynebacterium glutamicum

<400> 114

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Met Ser Leu Gly Ser Thr Pro Ser Thr Pro Glu Asn Leu Asn Pro Val
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Thr Arg Thr Ala Arg Gln Ala Leu Ile Leu Gln Ile Leu Asp Lys Gln
      20           25           30

Lys Val Thr Ser Gln Val Gln Leu Ser Glu Leu Leu Leu Asp Glu Gly
      35           40           45

Ile Asp Ile Thr Gln Ala Thr Leu Ser Arg Asp Leu Asp Glu Leu Gly
      50           55           60

Ala Arg Lys Val Arg Pro Asp Gly Gly Arg Ala Tyr Tyr Ala Val Gly
      65           70           75           80

Pro Val Asp Ser Ile Ala Arg Glu Asp Leu Arg Gly Pro Ser Glu Lys
      85           90           95

Leu Arg Arg Met Leu Asp Glu Leu Leu Val Ser Thr Asp His Ser Gly
      100          105          110

Asn Ile Ala Met Leu Arg Thr Pro Pro Gly Ala Ala Gln Tyr Leu Ala
      115          120          125

Ser Phe Ile Asp Arg Val Gly Leu Lys Glu Val Val Gly Thr Ile Ala
      130          135          140

Gly Asp Asp Thr Val Phe Val Leu Ala Arg Asp Pro Leu Thr Gly Lys
      145          150          155          160

Glu Leu Gly Glu Leu Leu Ser Gly Arg Thr Thr
      165          170

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<210> 115

<211> 486

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(463)

<223> RXA02201

<400> 115

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agtacttttc gtttgcgtcg gcaatggtgg aaaatctcaa atg gcc gca gcg cta 115
                               Met Ala Ala Ala Leu
                               1           5

gcc aaa aaa cat gcc ggg gac gct ctc aaa gtt tat tca gct ggc aca 163
Ala Lys Lys His Ala Gly Asp Ala Leu Lys Val Tyr Ser Ala Gly Thr
      10           15           20

aag cca ggt acg aaa tta aat caa cag tcc ctt gat tcc att gct gaa 211

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Lys Pro Gly Thr Lys Leu Asn Gln Gln Ser Leu Asp Ser Ile Ala Glu
 25 30 35
 gtt ggc gca gat atg tct caa ggg ttt cca aag ggc att gac cag gag 259
 Val Gly Ala Asp Met Ser Gln Gly Phe Pro Lys Gly Ile Asp Gln Glu
 40 45 50
 tta att aag cga gta gac cgc gtg gtc att ctt ggt gcc gaa gct caa 307
 Leu Ile Lys Arg Val Asp Arg Val Val Ile Leu Gly Ala Glu Ala Gln
 55 60 65
 cta gaa atg cct atc gat gca aac ggc ata cta cag cgc tgg gta act 355
 Leu Glu Met Pro Ile Asp Ala Asn Gly Ile Leu Gln Arg Trp Val Thr
 70 75 80 85
 gac gaa ccc tct gaa cgt gga att gaa ggt atg gaa cgc atg cgc ctg 403
 Asp Glu Pro Ser Glu Arg Gly Ile Glu Gly Met Glu Arg Met Arg Leu
 90 95 100
 gtc cga gat gat att gac gcc cga gtc caa aac ctc gtc gct gaa cta 451
 Val Arg Asp Asp Ile Asp Ala Arg Val Gln Asn Leu Val Ala Glu Leu
 105 110 115
 acc caa aac gca tagcagtttt ctaatctcac aca 486
 Thr Gln Asn Ala
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<210> 116

<211> 121

<212> PRT

<213> Corynebacterium glutamicum

<400> 116

Met Ala Ala Ala Leu Ala Lys Lys His Ala Gly Asp Ala Leu Lys Val
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 20 25 30
 Asp Ser Ile Ala Glu Val Gly Ala Asp Met Ser Gln Gly Phe Pro Lys
 35 40 45
 Gly Ile Asp Gln Glu Leu Ile Lys Arg Val Asp Arg Val Val Ile Leu
 50 55 60
 Gly Ala Glu Ala Gln Leu Glu Met Pro Ile Asp Ala Asn Gly Ile Leu
 65 70 75 80
 Gln Arg Trp Val Thr Asp Glu Pro Ser Glu Arg Gly Ile Glu Gly Met
 85 90 95
 Glu Arg Met Arg Leu Val Arg Asp Asp Ile Asp Ala Arg Val Gln Asn
 100 105 110
 Leu Val Ala Glu Leu Thr Gln Asn Ala
 115 120

| | |
|-------|-----|
| <210> | 118 |
| <211> | 129 |
| <212> | PRT |

<213> Corynebacterium glutamicum

<400> 118

Met Lys Ser Val Leu Phe Val Cys Val Gly Asn Gly Gly Lys Ser Gln
 1 5 10 15

Met Ala Ala Ala Leu Ala Gln Lys Tyr Ala Ser Asp Ser Val Glu Ile
 20 25 30

His Ser Ala Gly Thr Lys Pro Ala Gln Gly Leu Asn Gln Leu Ser Val
 35 40 45

Glu Ser Ile Ala Glu Val Gly Ala Asp Met Ser Gln Gly Ile Pro Lys
 50 55 60

Ala Ile Asp Pro Glu Leu Leu Arg Thr Val Asp Arg Val Val Ile Leu
 65 70 75 80

Gly Asp Asp Ala Gln Val Asp Met Pro Glu Ser Ala Gln Gly Ala Leu
 85 90 95

Glu Arg Trp Ser Ile Glu Glu Pro Asp Ala Gln Gly Met Glu Arg Met
 100 105 110

Arg Ile Val Arg Asp Gln Ile Asp Asn Arg Val Gln Ala Leu Leu Ala
 115 120 125

Gly

<210> 119

<211> 1221

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1198)

<223> RXA00600

<400> 119

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catcgatatt gaaggtatatt ttatatcggc aaacatcaat atg att gaa ggc tgg 115
 Met Ile Glu Gly Trp
 1 5

ctc atg acc ctt act aaa gag cat tcg aca cct cga gcg gct ggc tca 163
 Leu Met Thr Leu Thr Lys Glu His Ser Thr Pro Arg Ala Ala Gly Ser
 10 15 20

atg tcg ttt ctt gac cgc tgg tta gct gcc tgg att ttc ttg gct atg 211
 Met Ser Phe Leu Asp Arg Trp Leu Ala Ala Trp Ile Phe Leu Ala Met
 25 30 35

gct gct ggg ttg tta atc ggc aag gtc ttt cca gga att ggg gcg ctt 259

| | |
|---|-----|
| Ala Ala Gly Leu Leu Ile Gly Lys Val Phe Pro Gly Ile Gly Ala Leu | |
| 40 45 50 | |
| ttg agc gcg gtg gaa att ggt gga att tcc att cca att gct atc ggt | 307 |
| Leu Ser Ala Val Glu Ile Gly Gly Ile Ser Ile Pro Ile Ala Ile Gly | |
| 55 60 65 | |
| ttg atc gtc atg atg tat cca cct ttg gcc aag gtg cgc tac gac aaa | 355 |
| Leu Ile Val Met Met Tyr Pro Pro Leu Ala Lys Val Arg Tyr Asp Lys | |
| 70 75 80 85 | |
| act aaa gaa atc agc aca gac cgc gct ctc atg gtg gtg tcg att atg | 403 |
| Thr Lys Glu Ile Ser Thr Asp Arg Ala Leu Met Val Val Ser Ile Met | |
| 90 95 100 | |
| ttg aac tgg atc gtt gga cca gca ctt atg ttt agc ctg gcg tgg ctg | 451 |
| Leu Asn Trp Ile Val Gly Pro Ala Leu Met Phe Ser Leu Ala Trp Leu | |
| 105 110 115 | |
| ttt ctt cca gat caa cca gag ctt cgc act ggg cta att atc gtg ggc | 499 |
| Phe Leu Pro Asp Gln Pro Glu Leu Arg Thr Gly Leu Ile Ile Val Gly | |
| 120 125 130 | |
| ctt gcg cgc tgt atc gcg atg gtt ttg gta tgg agt gat ctc gct tgt | 547 |
| Leu Ala Arg Cys Ile Ala Met Val Leu Val Trp Ser Asp Leu Ala Cys | |
| 135 140 145 | |
| ggt gac cgg gaa gca act gct gtg ctg gtt gca atc aac tcg gtg ttc | 595 |
| Gly Asp Arg Glu Ala Thr Ala Val Leu Val Ala Ile Asn Ser Val Phe | |
| 150 155 160 165 | |
| cag atc ctt atg ttc ggt gtg ctt ggt tgg ttt tac ctg cag att ctt | 643 |
| Gln Ile Leu Met Phe Gly Val Leu Gly Trp Phe Tyr Leu Gln Ile Leu | |
| 170 175 180 | |
| ccc tcg tgg ctg gga tta gac acc acg tcg gtg act ttc tct gtg gta | 691 |
| Pro Ser Trp Leu Gly Leu Asp Thr Thr Ser Val Thr Phe Ser Val Val | |
| 185 190 195 | |
| tca atc gtg act tcc gtt ctc gtg ttc ttg ggc ata cca ctt gta gct | 739 |
| Ser Ile Val Thr Ser Val Leu Val Phe Leu Gly Ile Pro Leu Val Ala | |
| 200 205 210 | |
| gga gtt tta tct cgc gtc att ggt gaa aaa aca aag gga cgg cgc tgg | 787 |
| Gly Val Leu Ser Arg Val Ile Gly Glu Lys Thr Lys Gly Arg Arg Trp | |
| 215 220 225 | |
| tac gag gac acg ttc ctg cct aag att tca ccc ttg gcg ctg att ggc | 835 |
| Tyr Glu Asp Thr Phe Leu Pro Lys Ile Ser Pro Leu Ala Leu Ile Gly | |
| 230 235 240 245 | |
| ttg cta tac aca att gtt ctg ctg ttt tcg ttg cag ggg gat gaa atc | 883 |
| Leu Leu Tyr Thr Ile Val Leu Leu Phe Ser Leu Gln Gly Asp Glu Ile | |
| 250 255 260 | |
| aca gcg cag cct tgg aca gta gct cgt ctt gca ttg ccg ctg ctg atg | 931 |
| Thr Ala Gln Pro Trp Thr Val Ala Arg Leu Ala Leu Pro Leu Leu Met | |

| 265 | 270 | 275 | |
|---|-----|-----|------|
| tac ttt gtg ggc atg ttt ttc att tcc ctg gtg gta tcc aaa ctg tcc | | | 979 |
| Tyr Phe Val Gly Met Phe Phe Ile Ser Leu Val Val Ser Lys Leu Ser | | | |
| 280 | 285 | 290 | |
| ggg tta act tat gag cga gct gct tcc gtg tct ttt act gca gca gga | | | 1027 |
| Gly Leu Thr Tyr Glu Arg Ala Ala Ser Val Ser Phe Thr Ala Ala Gly | | | |
| 295 | 300 | 305 | |
| aac aac ttt gaa tta gcg att gcg gta tcg atc gga acc ttt ggt gcg | | | 1075 |
| Asn Asn Phe Glu Leu Ala Ile Ala Val Ser Ile Gly Thr Phe Gly Ala | | | |
| 310 | 315 | 320 | 325 |
| aca tca ccg cag gca tta gct gga acg atc ggc cct ttg att gaa gtc | | | 1123 |
| Thr Ser Pro Gln Ala Leu Ala Gly Thr Ile Gly Pro Leu Ile Glu Val | | | |
| 330 | 335 | 340 | |
| cca gta tta gtc gga ttg gtt tat gtc atg ttg tgg ctt gga cca aaa | | | 1171 |
| Pro Val Leu Val Gly Leu Val Tyr Val Met Leu Trp Leu Gly Pro Lys | | | |
| 345 | 350 | 355 | |
| atc ttt aaa aag gag aat gca gga tca tgaaatcagt tttgtttgtg | | | 1218 |
| Ile Phe Lys Lys Glu Asn Ala Gly Ser | | | |
| 360 | 365 | | |
| tgc | | | 1221 |

<210> 120

<211> 366

<212> PRT

<213> Corynebacterium glutamicum

<400> 120

| | | | |
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| Met Ile Glu Gly Trp Leu Met Thr Leu Thr Lys Glu His Ser Thr Pro | | | |
| 1 | 5 | 10 | 15 |
| Arg Ala Ala Gly Ser Met Ser Phe Leu Asp Arg Trp Leu Ala Ala Trp | | | |
| 20 | 25 | 30 | |
| Ile Phe Leu Ala Met Ala Ala Gly Leu Leu Ile Gly Lys Val Phe Pro | | | |
| 35 | 40 | 45 | |
| Gly Ile Gly Ala Leu Leu Ser Ala Val Glu Ile Gly Gly Ile Ser Ile | | | |
| 50 | 55 | 60 | |
| Pro Ile Ala Ile Gly Leu Ile Val Met Met Tyr Pro Pro Leu Ala Lys | | | |
| 65 | 70 | 75 | 80 |
| Val Arg Tyr Asp Lys Thr Lys Glu Ile Ser Thr Asp Arg Ala Leu Met | | | |
| 85 | 90 | 95 | |
| Val Val Ser Ile Met Leu Asn Trp Ile Val Gly Pro Ala Leu Met Phe | | | |
| 100 | 105 | 110 | |
| Ser Leu Ala Trp Leu Phe Leu Pro Asp Gln Pro Glu Leu Arg Thr Gly | | | |

| 115 | 120 | 125 |
|--|-----|-----|
| Leu Ile Ile Val Gly Leu Ala Arg Cys Ile Ala Met Val Leu Val Trp 130 135 140 | | |
| Ser Asp Leu Ala Cys Gly Asp Arg Glu Ala Thr Ala Val Leu Val Ala 145 150 155 160 | | |
| Ile Asn Ser Val Phe Gln Ile Leu Met Phe Gly Val Leu Gly Trp Phe 165 170 175 | | |
| Tyr Leu Gln Ile Leu Pro Ser Trp Leu Gly Leu Asp Thr Thr Ser Val 180 185 190 | | |
| Thr Phe Ser Val Val Ser Ile Val Thr Ser Val Leu Val Phe Leu Gly 195 200 205 | | |
| Ile Pro Leu Val Ala Gly Val Leu Ser Arg Val Ile Gly Glu Lys Thr 210 215 220 | | |
| Lys Gly Arg Arg Trp Tyr Glu Asp Thr Phe Leu Pro Lys Ile Ser Pro 225 230 235 240 | | |
| Leu Ala Leu Ile Gly Leu Leu Tyr Thr Ile Val Leu Leu Phe Ser Leu 245 250 255 | | |
| Gln Gly Asp Glu Ile Thr Ala Gln Pro Trp Thr Val Ala Arg Leu Ala 260 265 270 | | |
| Leu Pro Leu Leu Met Tyr Phe Val Gly Met Phe Phe Ile Ser Leu Val 275 280 285 | | |
| Val Ser Lys Leu Ser Gly Leu Thr Tyr Glu Arg Ala Ala Ser Val Ser 290 295 300 | | |
| Phe Thr Ala Ala Gly Asn Asn Phe Glu Leu Ala Ile Ala Val Ser Ile 305 310 315 320 | | |
| Gly Thr Phe Gly Ala Thr Ser Pro Gln Ala Leu Ala Gly Thr Ile Gly 325 330 335 | | |
| Pro Leu Ile Glu Val Pro Val Leu Val Gly Leu Val Tyr Val Met Leu 340 345 350 | | |
| Trp Leu Gly Pro Lys Ile Phe Lys Lys Glu Asn Ala Gly Ser 355 360 365 | | |

<210> 121
 <211> 1233
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1210)
 <223> RXA02200

<400> 121

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tttgaatatc gacaggtatc aatataccga aaggtgtcgc atg aca aac tca act 115
 Met Thr Asn Ser Thr
 1 5

cag acg cgg gcc aag cca gcc cga atc tca ttt ctt gat aaa tac att 163
 Gln Thr Arg Ala Lys Pro Ala Arg Ile Ser Phe Leu Asp Lys Tyr Ile
 10 15 20

cca ctt tgg att att ttg gcg atg gcg ttt ggg cta ttt tta ggc cgg 211
 Pro Leu Trp Ile Ile Leu Ala Met Ala Phe Gly Leu Phe Leu Gly Arg
 25 30 35

agc gtt tcg gga ctc tca ggc ttt cta ggc gca atg gaa gtc gga ggg 259
 Ser Val Ser Gly Leu Ser Gly Phe Leu Gly Ala Met Glu Val Gly Gly
 40 45 50

atc tcc ttg cca atc gct tta ggc ctc ctt gta atg atg tac cca ccg 307
 Ile Ser Leu Pro Ile Ala Leu Gly Leu Leu Val Met Met Tyr Pro Pro
 55 60 65

ttg gcc aaa gtt cgg tat gac aaa act aaa caa att gcc act gat aag 355
 Leu Ala Lys Val Arg Tyr Asp Lys Thr Lys Gln Ile Ala Thr Asp Lys
 70 75 80 85

cat ttg atg ggc gtg tca ctc att ctc aat tgg gtg gtg ggt cct gcc 403
 His Leu Met Gly Val Ser Leu Ile Leu Asn Trp Val Val Gly Pro Ala
 90 95 100

tta atg ttc gcg cta gct tgg ttg ttc ctc cca gac caa ccg gaa tta 451
 Leu Met Phe Ala Leu Ala Trp Leu Phe Leu Pro Asp Gln Pro Glu Leu
 105 110 115

cga acc ggc ctg att att gta gga ctc gca cga tgt att gcg atg gtc 499
 Arg Thr Gly Leu Ile Ile Val Gly Leu Ala Arg Cys Ile Ala Met Val
 120 125 130

ttg gtt tgg tct gat atg tcc tgt gga gac cgc gag gct aca gca gtt 547
 Leu Val Trp Ser Asp Met Ser Cys Gly Asp Arg Glu Ala Thr Ala Val
 135 140 145

ctc gta gcc att aat tca gtt ttt caa gtc gca atg ttt ggt gca ctt 595
 Leu Val Ala Ile Asn Ser Val Phe Gln Val Ala Met Phe Gly Ala Leu
 150 155 160 165

ggc tgg ttc tat ctg caa gtt tta cca tcc tgg cta gga tta cca act 643
 Gly Trp Phe Tyr Leu Gln Val Leu Pro Ser Trp Leu Gly Leu Pro Thr
 170 175 180

acc acc gct caa ttc tct ttc tgg tca att gtg act tcg gtt ttg gtg 691
 Thr Thr Ala Gln Phe Ser Phe Trp Ser Ile Val Thr Ser Val Leu Val
 185 190 195

ttc ctc gga ata cct cta ctt gct gga gtt ttc tcg cga att att ggc 739

Phe Leu Gly Ile Pro Leu Leu Ala Gly Val Phe Ser Arg Ile Ile Gly
 200 205 210

gaa aag atc aag gga cgt gag tgg tat gaa caa aag ttc ctt ccg gca 787
 Glu Lys Ile Lys Gly Arg Glu Trp Tyr Glu Gln Lys Phe Leu Pro Ala
 215 220 225

atc tct cca ttt gca cta atc ggt ctg ctt tat acg atc gtc ttg ttg 835
 Ile Ser Pro Phe Ala Leu Ile Gly Leu Leu Tyr Thr Ile Val Leu Leu
 230 235 240 245

ttt tca ttg caa ggt gat cag atc gtc tct caa cca tgg gct gta gtt 883
 Phe Ser Leu Gln Gly Asp Gln Ile Val Ser Gln Pro Trp Ala Val Val
 250 255 260

cgt ctc gcg ata cca ttg gtt atc tat ttc gtt gga atg ttt ttc att 931
 Arg Leu Ala Ile Pro Leu Val Ile Tyr Phe Val Gly Met Phe Phe Ile
 265 270 275

tca ctc att gcg tca aaa cta tct ggc atg aac tat gca aag tct gca 979
 Ser Leu Ile Ala Ser Lys Leu Ser Gly Met Asn Tyr Ala Lys Ser Ala
 280 285 290

tcc gtc tct ttc act gca gct ggc aac aat ttt gaa ctt gcg att gcg 1027
 Ser Val Ser Phe Thr Ala Ala Gly Asn Asn Phe Glu Leu Ala Ile Ala
 295 300 305

gtg tcg atc gga acg ttt ggc gca act tct gca cag gct atg gca gga 1075
 Val Ser Ile Gly Thr Phe Gly Ala Thr Ser Ala Gln Ala Met Ala Gly
 310 315 320 325

acg att ggt ccc ttg att gaa att cca gta ctt gtc ggc ttg gtc tac 1123
 Thr Ile Gly Pro Leu Ile Glu Ile Pro Val Leu Val Gly Leu Val Tyr
 330 335 340

gcc atg ctg tgg cta ggc ccc aag ttg ttc cca aat gac ccc acg ctg 1171
 Ala Met Leu Trp Leu Gly Pro Lys Leu Phe Pro Asn Asp Pro Thr Leu
 345 350 355

cca tca tca gct cgt tct acc agc caa atc atc aac tca tagcgaagga 1220
 Pro Ser Ser Ala Arg Ser Thr Ser Gln Ile Ile Asn Ser
 360 365 370

atcaacttca tga 1233

<210> 122
 <211> 370
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 122
 Met Thr Asn Ser Thr Gln Thr Arg Ala Lys Pro Ala Arg Ile Ser Phe
 1 5 10 15
 Leu Asp Lys Tyr Ile Pro Leu Trp Ile Ile Leu Ala Met Ala Phe Gly
 20 25 30

Leu Phe Leu Gly Arg Ser Val Ser Gly Leu Ser Gly Phe Leu Gly Ala
 35 40 45
 Met Glu Val Gly Gly Ile Ser Leu Pro Ile Ala Leu Gly Leu Leu Val
 50 55 60
 Met Met Tyr Pro Pro Leu Ala Lys Val Arg Tyr Asp Lys Thr Lys Gln
 65 70 75 80
 Ile Ala Thr Asp Lys His Leu Met Gly Val Ser Leu Ile Leu Asn Trp
 85 90 95
 Val Val Gly Pro Ala Leu Met Phe Ala Leu Ala Trp Leu Phe Leu Pro
 100 105 110
 Asp Gln Pro Glu Leu Arg Thr Gly Leu Ile Ile Val Gly Leu Ala Arg
 115 120 125
 Cys Ile Ala Met Val Leu Val Trp Ser Asp Met Ser Cys Gly Asp Arg
 130 135 140
 Glu Ala Thr Ala Val Leu Val Ala Ile Asn Ser Val Phe Gln Val Ala
 145 150 155 160
 Met Phe Gly Ala Leu Gly Trp Phe Tyr Leu Gln Val Leu Pro Ser Trp
 165 170 175
 Leu Gly Leu Pro Thr Thr Thr Ala Gln Phe Ser Phe Trp Ser Ile Val
 180 185 190
 Thr Ser Val Leu Val Phe Leu Gly Ile Pro Leu Leu Ala Gly Val Phe
 195 200 205
 Ser Arg Ile Ile Gly Glu Lys Ile Lys Gly Arg Glu Trp Tyr Glu Gln
 210 215 220
 Lys Phe Leu Pro Ala Ile Ser Pro Phe Ala Leu Ile Gly Leu Leu Tyr
 225 230 235 240
 Thr Ile Val Leu Leu Phe Ser Leu Gln Gly Asp Gln Ile Val Ser Gln
 245 250 255
 Pro Trp Ala Val Val Arg Leu Ala Ile Pro Leu Val Ile Tyr Phe Val
 260 265 270
 Gly Met Phe Phe Ile Ser Leu Ile Ala Ser Lys Leu Ser Gly Met Asn
 275 280 285
 Tyr Ala Lys Ser Ala Ser Val Ser Phe Thr Ala Ala Gly Asn Asn Phe
 290 295 300
 Glu Leu Ala Ile Ala Val Ser Ile Gly Thr Phe Gly Ala Thr Ser Ala
 305 310 315 320
 Gln Ala Met Ala Gly Thr Ile Gly Pro Leu Ile Glu Ile Pro Val Leu
 325 330 335

Val Gly Leu Val Tyr Ala Met Leu Trp Leu Gly Pro Lys Leu Phe Pro
 340 345 350

Asn Asp Pro Thr Leu Pro Ser Ser Ala Arg Ser Thr Ser Gln Ile Ile
 355 360 365

Asn Ser
 370

<210> 123

<211> 762

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(739)

<223> RXA02202

<400> 123

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aatctattgg tttccccgta aaatcttcga aaggaagaac atg acc ggg caa gct 115
 Met Thr Gly Gln Ala
 1 5

gca cca aac ttg cat acc aat att ttg aac cgt atc gca aat gaa ctg 163
 Ala Pro Asn Leu His Thr Asn Ile Leu Asn Arg Ile Ala Asn Glu Leu
 10 15 20

gcg ttg acc tat caa gga gtt ttc tct gca gag act atc aac cgc tat 211
 Ala Leu Thr Tyr Gln Gly Val Phe Ser Ala Glu Thr Ile Asn Arg Tyr
 25 30 35

att ttt gaa tcg tat gtg tcg ttg gcg aga aca gca aaa atc cat acg 259
 Ile Phe Glu Ser Tyr Val Ser Leu Ala Arg Thr Ala Lys Ile His Thr
 40 45 50

cac ctg cca att ttg gca gaa ggt ttt gct aaa gac cgg ctg cac gca 307
 His Leu Pro Ile Leu Ala Glu Gly Phe Ala Lys Asp Arg Leu His Ala
 55 60 65

ctt gcg gta gct gaa ggt aag gtg gct tca cct gtg cct cag gtc cta 355
 Leu Ala Val Ala Glu Gly Lys Val Ala Ser Pro Val Pro Gln Val Leu
 70 75 80 85

ttt att tgc gtc cac aac gca ggt cgt tca caa att gct tcg gcg ttg 403
 Phe Ile Cys Val His Asn Ala Gly Arg Ser Gln Ile Ala Ser Ala Leu
 90 95 100

ttg tct cac tat gcc ggt agt tct gta gag gta cgt tct gca ggt tct 451
 Leu Ser His Tyr Ala Gly Ser Ser Val Glu Val Arg Ser Ala Gly Ser
 105 110 115

tta cct gct tct gaa att cac cca ctg gtg ttg gaa att ttg tca gag 499

Leu Pro Ala Ser Glu Ile His Pro Leu Val Leu Glu Ile Leu Ser Glu
 120 125 130
 cga gga gtg aac att tct gat gca ttt ccg aaa ccg cta acc gat gat 547
 Arg Gly Val Asn Ile Ser Asp Ala Phe Pro Lys Pro Leu Thr Asp Asp
 135 140 145
 gtt att cgc gca tct gac tat gtc ata aca atg gga tgt gga gat gtg 595
 Val Ile Arg Ala Ser Asp Tyr Val Ile Thr Met Gly Cys Gly Asp Val
 150 155 160 165
 tgc cca atg tat cca gga aag cac tat ctc gat tgg gag ctc gct gat 643
 Cys Pro Met Tyr Pro Gly Lys His Tyr Leu Asp Trp Glu Leu Ala Asp
 170 175 180
 ccg tca gat gaa ggt gag gac aag ata cag gaa ata att gag gaa att 691
 Pro Ser Asp Glu Gly Glu Asp Lys Ile Gln Glu Ile Ile Glu Glu Ile
 185 190 195
 gac ggt cga atc cgc gag ctt tgg aaa agc att caa tta tcg caa aac 739
 Asp Gly Arg Ile Arg Glu Leu Trp Lys Ser Ile Gln Leu Ser Gln Asn
 200 205 210
 taggcagtca aaggtctggc acc 762

<210> 124
 <211> 213
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 124
 Met Thr Gly Gln Ala Ala Pro Asn Leu His Thr Asn Ile Leu Asn Arg
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 Ile Ala Asn Glu Leu Ala Leu Thr Tyr Gln Gly Val Phe Ser Ala Glu
 20 25 30
 Thr Ile Asn Arg Tyr Ile Phe Glu Ser Tyr Val Ser Leu Ala Arg Thr
 35 40 45
 Ala Lys Ile His Thr His Leu Pro Ile Leu Ala Glu Gly Phe Ala Lys
 50 55 60
 Asp Arg Leu His Ala Leu Ala Val Ala Glu Gly Lys Val Ala Ser Pro
 65 70 75 80
 Val Pro Gln Val Leu Phe Ile Cys Val His Asn Ala Gly Arg Ser Gln
 85 90 95
 Ile Ala Ser Ala Leu Leu Ser His Tyr Ala Gly Ser Ser Val Glu Val
 100 105 110
 Arg Ser Ala Gly Ser Leu Pro Ala Ser Glu Ile His Pro Leu Val Leu
 115 120 125
 Glu Ile Leu Ser Glu Arg Gly Val Asn Ile Ser Asp Ala Phe Pro Lys

130 135 140
 Pro Leu Thr Asp Asp Val Ile Arg Ala Ser Asp Tyr Val Ile Thr Met
 145 150 155 160
 Gly Cys Gly Asp Val Cys Pro Met Tyr Pro Gly Lys His Tyr Leu Asp
 165 170 175
 Trp Glu Leu Ala Asp Pro Ser Asp Glu Gly Glu Asp Lys Ile Gln Glu
 180 185 190
 Ile Ile Glu Glu Ile Asp Gly Arg Ile Arg Glu Leu Trp Lys Ser Ile
 195 200 205
 Gln Leu Ser Gln Asn
 210

 <210> 125
 <211> 1002
 <212> DNA
 <213> Corynebacterium glutamicum

 <220>
 <221> CDS
 <222> (101)..(979)
 <223> RXA02205

 <400> 125
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 caccacacta ctgaggtcat aaggtagtagc ggtagatcgg gtg aat gaa gag ata 115
 Val Asn Glu Glu Ile
 1 5
 acc ctc cta gcc gca gca gca gat cct gcc gca act gaa aat att ggc 163
 Thr Leu Leu Ala Ala Ala Ala Asp Pro Ala Ala Thr Glu Asn Ile Gly
 10 15 20
 tgg gta caa acc att gtg ctc tcc atc gtt caa ggc ctc aca gag ttc 211
 Trp Val Gln Thr Ile Val Leu Ser Ile Val Gln Gly Leu Thr Glu Phe
 25 30 35
 ctg ccg atc agc tcc agc gga cac ctc cga atc atc tct gag ctg ttc 259
 Leu Pro Ile Ser Ser Ser Gly His Leu Arg Ile Ile Ser Glu Leu Phe
 40 45 50
 tgg ggt gcc gat gcc ggc gcg tcc ttt acc gcc gtg gtt cag ctt ggt 307
 Trp Gly Ala Asp Ala Gly Ala Ser Phe Thr Ala Val Val Gln Leu Gly
 55 60 65
 acc gaa gcc gca gtg ctg gtg ttt ttt gcc aag gaa atc tgg caa atc 355
 Thr Glu Ala Ala Val Leu Val Phe Phe Ala Lys Glu Ile Trp Gln Ile
 70 75 80 85
 atc aca ggt tgg ttc gct ggc gta ttc aat aag gaa cgc cgc gga ttt 403
 Ile Thr Gly Trp Phe Ala Gly Val Phe Asn Lys Glu Arg Arg Gly Phe

| | 90 | 95 | 100 | |
|---|-----|-----|-----|------|
| gaa tac cgc atg ggc tgg atg atc att gtt gcc acc att ccc gtc gtg | | | | 451 |
| Glu Tyr Arg Met Gly Trp Met Ile Ile Val Ala Thr Ile Pro Val Val | | | | |
| | 105 | 110 | 115 | |
| atc ttg ggt gtg ttg ggc aag gac ctg atc cgt gag gcg ctg cga aat | | | | 499 |
| Ile Leu Gly Val Leu Gly Lys Asp Leu Ile Arg Glu Ala Leu Arg Asn | | | | |
| | 120 | 125 | 130 | |
| atg tgg atc act gca tcc gtg ctg atc ctg ttc tcc ctg gtg ttc att | | | | 547 |
| Met Trp Ile Thr Ala Ser Val Leu Ile Leu Phe Ser Leu Val Phe Ile | | | | |
| | 135 | 140 | 145 | |
| ttg gcc gag aag atg ggc aag aag gaa cgc gac tac gac aaa ctg acc | | | | 595 |
| Leu Ala Glu Lys Met Gly Lys Lys Glu Arg Asp Tyr Asp Lys Leu Thr | | | | |
| | 150 | 155 | 160 | 165 |
| atg aaa gat gcc atc atc atg ggt ctt gca cag tgt ctt gcg ctg atc | | | | 643 |
| Met Lys Asp Ala Ile Ile Met Gly Leu Ala Gln Cys Leu Ala Leu Ile | | | | |
| | 170 | 175 | 180 | |
| cct ggc gtg tct cgc tcc ggc ggc acc atc tct gct ggt ttg ttc ctt | | | | 691 |
| Pro Gly Val Ser Arg Ser Gly Gly Thr Ile Ser Ala Gly Leu Phe Leu | | | | |
| | 185 | 190 | 195 | |
| ggt ctc aag cgt gaa gta gcc acc aag ttc tcc ttc ctg ctg gca atc | | | | 739 |
| Gly Leu Lys Arg Glu Val Ala Thr Lys Phe Ser Phe Leu Leu Ala Ile | | | | |
| | 200 | 205 | 210 | |
| cct gca gtg ctt ggc tcc ggt ttg tac tcc ctg cct gac gct ttt gcg | | | | 787 |
| Pro Ala Val Leu Gly Ser Gly Leu Tyr Ser Leu Pro Asp Ala Phe Ala | | | | |
| | 215 | 220 | 225 | |
| cca agc tcc gga caa gct gcc tcc ggc cta cag ctc acc gtg ggt acc | | | | 835 |
| Pro Ser Ser Gly Gln Ala Ala Ser Gly Leu Gln Leu Thr Val Gly Thr | | | | |
| | 230 | 235 | 240 | 245 |
| ctg gtt gcc ttc gta gtt ggc tac att tcc att gcg tgg ctg atg aag | | | | 883 |
| Leu Val Ala Phe Val Val Gly Tyr Ile Ser Ile Ala Trp Leu Met Lys | | | | |
| | 250 | 255 | 260 | |
| ttc gtg gca aac cac tcc ttc agc tgg ttt gct gca tac cgt att cct | | | | 931 |
| Phe Val Ala Asn His Ser Phe Ser Trp Phe Ala Ala Tyr Arg Ile Pro | | | | |
| | 265 | 270 | 275 | |
| gca ggt ctg ctc gtg atg ctg ctg ctc gca ctg ggc atg ctc aac cca | | | | 979 |
| Ala Gly Leu Leu Val Met Leu Leu Leu Ala Leu Gly Met Leu Asn Pro | | | | |
| | 280 | 285 | 290 | |
| taaaattcct gtacatctta aaa | | | | 1002 |

<210> 126

<211> 293

<212> PRT

<213> Corynebacterium glutamicum

<400> 126

Val Asn Glu Glu Ile Thr Leu Leu Ala Ala Ala Asp Pro Ala Ala
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Thr Glu Asn Ile Gly Trp Val Gln Thr Ile Val Leu Ser Ile Val Gln
 20 25 30

Gly Leu Thr Glu Phe Leu Pro Ile Ser Ser Ser Gly His Leu Arg Ile
 35 40 45

Ile Ser Glu Leu Phe Trp Gly Ala Asp Ala Gly Ala Ser Phe Thr Ala
 50 55 60

Val Val Gln Leu Gly Thr Glu Ala Ala Val Leu Val Phe Phe Ala Lys
 65 70 75 80

Glu Ile Trp Gln Ile Ile Thr Gly Trp Phe Ala Gly Val Phe Asn Lys
 85 90 95

Glu Arg Arg Gly Phe Glu Tyr Arg Met Gly Trp Met Ile Ile Val Ala
 100 105 110

Thr Ile Pro Val Val Ile Leu Gly Val Leu Gly Lys Asp Leu Ile Arg
 115 120 125

Glu Ala Leu Arg Asn Met Trp Ile Thr Ala Ser Val Leu Ile Leu Phe
 130 135 140

Ser Leu Val Phe Ile Leu Ala Glu Lys Met Gly Lys Lys Glu Arg Asp
 145 150 155 160

Tyr Asp Lys Leu Thr Met Lys Asp Ala Ile Ile Met Gly Leu Ala Gln
 165 170 175

Cys Leu Ala Leu Ile Pro Gly Val Ser Arg Ser Gly Gly Thr Ile Ser
 180 185 190

Ala Gly Leu Phe Leu Gly Leu Lys Arg Glu Val Ala Thr Lys Phe Ser
 195 200 205

Phe Leu Leu Ala Ile Pro Ala Val Leu Gly Ser Gly Leu Tyr Ser Leu
 210 215 220

Pro Asp Ala Phe Ala Pro Ser Ser Gly Gln Ala Ala Ser Gly Leu Gln
 225 230 235 240

Leu Thr Val Gly Thr Leu Val Ala Phe Val Val Gly Tyr Ile Ser Ile
 245 250 255

Ala Trp Leu Met Lys Phe Val Ala Asn His Ser Phe Ser Trp Phe Ala
 260 265 270

Ala Tyr Arg Ile Pro Ala Gly Leu Leu Val Met Leu Leu Leu Ala Leu
 275 280 285

Gly Met Leu Asn Pro

290

<210> 127
 <211> 975
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(952)
 <223> RXA00900

<400> 127

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gtgcggtggc tgcgctggtc gctagtgtgg tgtgcgcgct ggcgccgtcg ataagcgtat 60
tagtgatcgc acgcctgggtg caggggcttg gcggcggtgc gtg cgt ggt att gcg 115
                               Val Arg Gly Ile Ala
                               1                               5

cgc gcg atc gtg cca gac ctt gaa cgc gga caa aag gct gcg cac gcc 163
Arg Ala Ile Val Pro Asp Leu Glu Arg Gly Gln Lys Ala Ala His Ala
                10                15                20

ttt gca ctg ctg atg att att cag gga att gct ccc gtg gta gct ccg 211
Phe Ala Leu Leu Met Ile Ile Gln Gly Ile Ala Pro Val Val Ala Pro
                25                30                35

ctc att ggt ggt gtg ctg gtc ggg cct ttt ggc tgg cgg gga att ttc 259
Leu Ile Gly Gly Val Leu Val Gly Pro Phe Gly Trp Arg Gly Ile Phe
                40                45                50

tgg gca ctt gca ctg gtg aat ttt gcg cag ctg ctt gtt gct ttg ctg 307
Trp Ala Leu Ala Leu Val Asn Phe Ala Gln Leu Leu Val Ala Leu Leu
                55                60                65

cag att aag gag tcg aag cca gtt gaa gag cgt acc gca gca gga ctt 355
Gln Ile Lys Glu Ser Lys Pro Val Glu Glu Arg Thr Ala Ala Gly Leu
                70                75                80                85

ggc gga atg ctg tcc aac tat gtc ttt gtg ctg aag aat cct caa ttt 403
Gly Gly Met Leu Ser Asn Tyr Val Phe Val Leu Lys Asn Pro Gln Phe
                90                95                100

ttg gca tat gta ttc aca ttg ggg ctg tct ttt ggg gcg atg ttc tcc 451
Leu Ala Tyr Val Phe Thr Leu Gly Leu Ser Phe Gly Ala Met Phe Ser
                105                110                115

tac att tcg gcg tcg ccg ttc gtg ctg cag aat caa atg ggc att ccg 499
Tyr Ile Ser Ala Ser Pro Phe Val Leu Gln Asn Gln Met Gly Ile Pro
                120                125                130

gta ctg ctg tat tcc att att ttc gga gtg aat gct ttt ggt ttg att 547
Val Leu Leu Tyr Ser Ile Ile Phe Gly Val Asn Ala Phe Gly Leu Ile
                135                140                145

gtg ggc gga atg gtc aat agg cga ctt ctg cag cgg att cat cca cac 595

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Val Gly Gly Met Val Asn Arg Arg Leu Leu Gln Arg Ile His Pro His
 150 155 160 165
 cgc atc atg caa act gtg ctg gcc agt ttt act gtg ctg tgt gcg ctt 643
 Arg Ile Met Gln Thr Val Leu Ala Ser Phe Thr Val Leu Cys Ala Leu
 170 175 180
 ttg ctg att gaa gtg ctg ttt att aat tgg ata ccg ctg ttc ctg ttg 691
 Leu Leu Ile Glu Val Leu Phe Ile Asn Trp Ile Pro Leu Phe Leu Leu
 185 190 195
 ctg ctg ttt ctt atc gtt tcc cat att ccg atg gtt atg gct aac gcg 739
 Leu Leu Phe Leu Ile Val Ser His Ile Pro Met Val Met Ala Asn Ala
 200 205 210
 aca gct ctg gga act gaa gtg gtg cga agc agg gcg gga tcg ggt tct 787
 Thr Ala Leu Gly Thr Glu Val Val Arg Ser Arg Ala Gly Ser Gly Ser
 215 220 225
 gca att ttg ggt ttc gtg caa ttc acg atg ggt gct ttg gtg agt tca 835
 Ala Ile Leu Gly Phe Val Gln Phe Thr Met Gly Ala Leu Val Ser Ser
 230 235 240 245
 ctg gtc gga tta ggc tct gat aag gct ttg act atg gga atc gca atg 883
 Leu Val Gly Leu Gly Ser Asp Lys Ala Leu Thr Met Gly Ile Ala Met
 250 255 260
 act gct tgt gca ctg ctg gcg tgt ggg tgt gcg tac ctg gca ggt cga 931
 Thr Ala Cys Ala Leu Leu Ala Cys Gly Cys Ala Tyr Leu Ala Gly Arg
 265 270 275
 aaa ggt att cca gaa atg aag tagctctagg tggcgtttta agg 975
 Lys Gly Ile Pro Glu Met Lys
 280

<210> 128
 <211> 284
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 128
 Val Arg Gly Ile Ala Arg Ala Ile Val Pro Asp Leu Glu Arg Gly Gln
 1 5 10 15
 Lys Ala Ala His Ala Phe Ala Leu Leu Met Ile Ile Gln Gly Ile Ala
 20 25 30
 Pro Val Val Ala Pro Leu Ile Gly Gly Val Leu Val Gly Pro Phe Gly
 35 40 45
 Trp Arg Gly Ile Phe Trp Ala Leu Ala Leu Val Asn Phe Ala Gln Leu
 50 55 60
 Leu Val Ala Leu Leu Gln Ile Lys Glu Ser Lys Pro Val Glu Glu Arg
 65 70 75 80

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<210> 129
<211> 537
<212> DNA
<213> Corynebacterium glutamicum
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<220>  
<221> CDS  
<222> (101)..(514)  
<223> RXN00901
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<400> 129
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aaataaccccc aaatcttcga tatagataca cgagacagtg atg cag aaa aaa caa 115
Met Gln Lys Lys Gln
1 5
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cag ctg agc acc gcc ctg att atg gga ttg gca tta ttg tca gcc agc 163
 Gln Leu Ser Thr Ala Leu Ile Met Gly Leu Ala Leu Leu Ser Ala Ser
 10 15 20

tcc gcg cta gcg act gat atg tat ttg ccg gca atg cct ggt att gcg 211
 Ser Ala Leu Ala Thr Asp Met Tyr Leu Pro Ala Met Pro Gly Ile Ala
 25 30 35

gaa gat ttg ggg aca act gca ccg atg gtg cag tta act ctt tct tcc 259
 Glu Asp Leu Gly Thr Thr Ala Pro Met Val Gln Leu Thr Leu Ser Ser
 40 45 50

ttt atg gct gga atg gcg att ggc caa ttg atc att ggt cct ttg tcg 307
 Phe Met Ala Gly Met Ala Ile Gly Gln Leu Ile Ile Gly Pro Leu Ser
 55 60 65

gat caa ttg gga agg aaa ggc ctg ctc gtt gca ggt gcg gtg gct gcg 355
 Asp Gln Leu Gly Arg Lys Gly Leu Leu Val Ala Gly Ala Val Ala Ala
 70 75 80 85

ctg gtc gct agt gtg gtg tgc gcg ctg gcg ccg tcg ata agc gta tta 403
 Leu Val Ala Ser Val Val Cys Ala Leu Ala Pro Ser Ile Ser Val Leu
 90 95 100

gtg atc gca cgc ctg gtg cag ggg ctt ggc ggc ggt gcg tgc gtg gta 451
 Val Ile Ala Arg Leu Val Gln Gly Leu Gly Gly Gly Ala Cys Val Val
 105 110 115

ttg cgc gcg cga tcg tgc cag acc ttg aac gcg gac aaa agg ctg cgc 499
 Leu Arg Ala Arg Ser Cys Gln Thr Leu Asn Ala Asp Lys Arg Leu Arg
 120 125 130

acg cct ttg cac tgc tgatgattat tcagggaatt gct 537
 Thr Pro Leu His Cys
 135

<210> 130

<211> 138

<212> PRT

<213> Corynebacterium glutamicum

<400> 130

Met Gln Lys Lys Gln Gln Leu Ser Thr Ala Leu Ile Met Gly Leu Ala
 1 5 10 15

Leu Leu Ser Ala Ser Ser Ala Leu Ala Thr Asp Met Tyr Leu Pro Ala
 20 25 30

Met Pro Gly Ile Ala Glu Asp Leu Gly Thr Thr Ala Pro Met Val Gln
 35 40 45

Leu Thr Leu Ser Ser Phe Met Ala Gly Met Ala Ile Gly Gln Leu Ile
 50 55 60

Ile Gly Pro Leu Ser Asp Gln Leu Gly Arg Lys Gly Leu Leu Val Ala
 65 70 75 80

Gly Ala Val Ala Ala Leu Val Ala Ser Val Val Cys Ala Leu Ala Pro
85 90 95

Ser Ile Ser Val Leu Val Ile Ala Arg Leu Val Gln Gly Leu Gly Gly
100 105 110

Gly Ala Cys Val Val Leu Arg Ala Arg Ser Cys Gln Thr Leu Asn Ala
115 120 125

Asp Lys Arg Leu Arg Thr Pro Leu His Cys
130 135

<210> 131

<211> 501

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

 $\langle 222 \rangle \quad (1\bar{0}1) \dots (478)$

<223> FRXA00901

<400> 131

acctgaatga aaattttctaa ttaaaaaatc ccccaaattc tcgatataga tacacgagac 60

agtgatgcag aaaaaacaac agctgagcac cgccctgatt atg gga ttg gca tta 115
Met Gly Leu Ala Leu
1 5

ttg tca gcc agc tcc gcg cta gcg act gat atg tat ttg ccg gca atg 163
Leu Ser Ala Ser Ser Ala Leu Ala Thr Asp Met Tyr Leu Pro Ala Met
10 15 20

cct ggt att gcg gaa gat ttg ggg aca act gca ccg atg gtg cag tta 211
Pro Gly Ile Ala Glu Asp Leu Gly Thr Thr Ala Pro Met Val Gln Leu
25 30 35

act ctt tct tcc ttt atg gct gga atg gcg att ggc caa ttg atc att 259
Thr Leu Ser Ser Phe Met Ala Gly Met Ala Ile Gly Gln Leu Ile Ile
40 45 50

ggt cct ttg tcg gat caa ttg gga agg aaa ggc ctg ctc gtt gca ggt 307
Gly Pro Leu Ser Asp Gln Leu Gly Arg Lys Gly Leu Leu Val Ala Gly
55 60 65

gcg gtg gct gcg ctg gtc gct agt gtg gtg tgc gcg ctg gcg ccg tcg 355
Ala Val Ala Ala Leu Val Ala Ser Val Val Cys Ala Leu Ala Pro Ser
70 75 80 85

ata agc gta tta gtg atc gca cgc ctg gtg cag ggg ctt ggc ggc ggt 403
Ile Ser Val Leu Val Ile Ala Arg Leu Val Gln Gly Leu Gly Gly Gly
90 95 100

gcg tgc gtg gta ttg cgc gcg cga tcg tgc cag acc ttg aac gcg gac 451
Ala Cys Val Val Leu Arg Ala Arg Ser Cys Gln Thr Leu Asn Ala Asp

105

110

115

aaa agg ctg cgc acg cct ttg cac tgc tgatgattat tcagggaatt
 Lys Arg Leu Arg Thr Pro Leu His Cys
 120 125

498

gct

501

<210> 132

<211> 126

<212> PRT

<213> Corynebacterium glutamicum

<400> 132

Met Gly Leu Ala Leu Leu Ser Ala Ser Ser Ala Leu Ala Thr Asp Met
 1 5 10 15

Tyr Leu Pro Ala Met Pro Gly Ile Ala Glu Asp Leu Gly Thr Thr Ala
 20 25 30

Pro Met Val Gln Leu Thr Leu Ser Ser Phe Met Ala Gly Met Ala Ile
 35 40 45

Gly Gln Leu Ile Ile Gly Pro Leu Ser Asp Gln Leu Gly Arg Lys Gly
 50 55 60

Leu Leu Val Ala Gly Ala Val Ala Ala Leu Val Ala Ser Val Val Cys
 65 70 75 80

Ala Leu Ala Pro Ser Ile Ser Val Leu Val Ile Ala Arg Leu Val Gln
 85 90 95

Gly Leu Gly Gly Gly Ala Cys Val Val Leu Arg Ala Arg Ser Cys Gln
 100 105 110

Thr Leu Asn Ala Asp Lys Arg Leu Arg Thr Pro Leu His Cys
 115 120 125

<210> 133

<211> 1299

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1276)

<223> RXA00289

<400> 133

cctccccata agttcactca agcaagttct cccgaacaga ttcacccgag aagtcgacag 60

accccatata acagcccgat tcaagaaagg ctctgcagcc atg agc acc acc acc 115
 Met Ser Thr Thr Thr
 1 5

| | |
|---|-----|
| gcg ccc gaa gca cgg ttt cct gtc gtc cct ttg acc gcc atg agt ttc | 163 |
| Ala Pro Glu Ala Arg Phe Pro Val Val Pro Leu Thr Ala Met Ser Phe | |
| 10 15 20 | |
| gcg gca ttt gtt tat gtc acg ttc gag atg ttt gca gtt ggc ctc atc | 211 |
| Ala Ala Phe Val Tyr Val Thr Phe Glu Met Phe Ala Val Gly Leu Ile | |
| 25 30 35 | |
| aag ccg atg gcc agc gat ctt gga gtg tca gaa tcc agc atc ggc ctg | 259 |
| Lys Pro Met Ala Ser Asp Leu Gly Val Ser Glu Ser Ser Ile Gly Leu | |
| 40 45 50 | |
| ttg atg act gtg tat gcg act gtc gtt gcc gtg gtg acg atc cct gcc | 307 |
| Leu Met Thr Val Tyr Ala Thr Val Val Ala Val Val Thr Ile Pro Ala | |
| 55 60 65 | |
| atg ttg tgg gtt tct cga ttt aac aag cgc aca gtt ttc ctg att act | 355 |
| Met Leu Trp Val Ser Arg Phe Asn Lys Arg Thr Val Phe Leu Ile Thr | |
| 70 75 80 85 | |
| ctg gca ttt ttg gcc acg ggc att gtt gtt cag gca ctg acc gtt aat | 403 |
| Leu Ala Phe Leu Ala Thr Gly Ile Val Val Gln Ala Leu Thr Val Asn | |
| 90 95 100 | |
| tat gga atg cta gcc atc ggc cgc act atc gca gca ttg act cac ggg | 451 |
| Tyr Gly Met Leu Ala Ile Gly Arg Thr Ile Ala Ala Leu Thr His Gly | |
| 105 110 115 | |
| gtg ttt tgg gca ctt gtt ggg cca atg gca gcg cgt atg tcc cca ggt | 499 |
| Val Phe Trp Ala Leu Val Gly Pro Met Ala Ala Arg Met Ser Pro Gly | |
| 120 125 130 | |
| cac act ggt cgt gca gta ggc gtt gtg tcg att gga tca acc atg gcg | 547 |
| His Thr Gly Arg Ala Val Gly Val Val Ser Ile Gly Ser Thr Met Ala | |
| 135 140 145 | |
| ctg gtc gtt ggt tct ccg ctg gca aca tgg atc ggt gaa ctc atc gga | 595 |
| Leu Val Val Gly Ser Pro Leu Ala Thr Trp Ile Gly Glu Leu Ile Gly | |
| 150 155 160 165 | |
| tgg cgt cct gcc acc tgg att ctt ggt gcg ctg acc att gcg gcc gtg | 643 |
| Trp Arg Pro Ala Thr Trp Ile Leu Gly Ala Leu Thr Ile Ala Ala Val | |
| 170 175 180 | |
| gct gta ctc att cca acc gtt cca tca ctg cca cca ctt cca gac acg | 691 |
| Ala Val Leu Ile Pro Thr Val Pro Ser Leu Pro Pro Leu Pro Asp Thr | |
| 185 190 195 | |
| gaa tca gag tcc aaa gaa aag aaa tcc ctt cca tgg ggt ctc att tcc | 739 |
| Glu Ser Glu Ser Lys Glu Lys Lys Ser Leu Pro Trp Gly Leu Ile Ser | |
| 200 205 210 | |
| ctg gtc att ttc ctt ctc ctt gcc gtc acc ggt gtt ttt gct gcc tac | 787 |
| Leu Val Ile Phe Leu Leu Leu Ala Val Thr Gly Val Phe Ala Ala Tyr | |
| 215 220 225 | |
| acc tac ctt ggc ctc atc atc gct gaa aca gca ggg gac agc ttc gtg | 835 |

Thr Tyr Leu Gly Leu Ile Ile Ala Glu Thr Ala Gly Asp Ser Phe Val
 230 235 240 245
 tcc att ggc ttg ttc gcc ttc ggt gca ctc gga ctc att ggc gtg aca 883
 Ser Ile Gly Leu Phe Ala Phe Gly Ala Leu Gly Leu Ile Gly Val Thr
 250 255 260
 gtg gca acc cga act gtg gat caa cgc atg ctg cgt gga agt gtt cac 931
 Val Ala Thr Arg Thr Val Asp Gln Arg Met Leu Arg Gly Ser Val His
 265 270 275
 acc acc act ttg ttt gtc att gct gca att ctc gga cag atc gca ttc 979
 Thr Thr Thr Leu Phe Val Ile Ala Ala Ile Leu Gly Gln Ile Ala Phe
 280 285 290
 gga tta gag ggc aca cta gcc gta gta gct atc ttc ctt gca gtc acc 1027
 Gly Leu Glu Gly Thr Leu Ala Val Val Ala Ile Phe Leu Ala Val Thr
 295 300 305
 gtg ttt ggt gga gca tac ggc gct ctc cca acc ctg gga acc acc atc 1075
 Val Phe Gly Gly Ala Tyr Gly Ala Leu Pro Thr Leu Gly Thr Thr Ile
 310 315 320 325
 ttc ctc cat gcg ggt cgc gac cac cca gat act gca tcc tcc att tat 1123
 Phe Leu His Ala Gly Arg Asp His Pro Asp Thr Ala Ser Ser Ile Tyr
 330 335 340
 gtg gtc act tac caa gtg ggt atc gcg tct ggc gcg gca ctt ggc gcg 1171
 Val Val Thr Tyr Gln Val Gly Ile Ala Ser Gly Ala Ala Leu Gly Ala
 345 350 355
 atg gct gtg gat gcc gat tgg gtt gct ggc act ttg tgg atc atg gct 1219
 Met Ala Val Asp Ala Asp Trp Val Ala Gly Thr Leu Trp Ile Met Ala
 360 365 370
 gga ctg tca ttg gct tcc acg ttg gcc ttg gcg ctg tgg tcc cgc ccg 1267
 Gly Leu Ser Leu Ala Ser Thr Leu Ala Leu Ala Leu Trp Ser Arg Pro
 375 380 385
 cta ctg aag tagcagccca aattcagccc act 1299
 Leu Leu Lys
 390

<210> 134
 <211> 392
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 134
 Met Ser Thr Thr Thr Ala Pro Glu Ala Arg Phe Pro Val Val Pro Leu
 1 5 10 15
 Thr Ala Met Ser Phe Ala Ala Phe Val Tyr Val Thr Phe Glu Met Phe
 20 25 30
 Ala Val Gly Leu Ile Lys Pro Met Ala Ser Asp Leu Gly Val Ser Glu

| 35 | 40 | 45 |
|---|-----|-----|
| Ser Ser Ile Gly Leu Leu Met Thr Val Tyr Ala Thr Val Val Ala Val | | |
| 50 | 55 | 60 |
| Val Thr Ile Pro Ala Met Leu Trp Val Ser Arg Phe Asn Lys Arg Thr | | |
| 65 | 70 | 75 |
| Val Phe Leu Ile Thr Leu Ala Phe Leu Ala Thr Gly Ile Val Val Gln | | |
| 85 | 90 | 95 |
| Ala Leu Thr Val Asn Tyr Gly Met Leu Ala Ile Gly Arg Thr Ile Ala | | |
| 100 | 105 | 110 |
| Ala Leu Thr His Gly Val Phe Trp Ala Leu Val Gly Pro Met Ala Ala | | |
| 115 | 120 | 125 |
| Arg Met Ser Pro Gly His Thr Gly Arg Ala Val Gly Val Val Ser Ile | | |
| 130 | 135 | 140 |
| Gly Ser Thr Met Ala Leu Val Val Gly Ser Pro Leu Ala Thr Trp Ile | | |
| 145 | 150 | 155 |
| Gly Glu Leu Ile Gly Trp Arg Pro Ala Thr Trp Ile Leu Gly Ala Leu | | |
| 165 | 170 | 175 |
| Thr Ile Ala Ala Val Ala Val Leu Ile Pro Thr Val Pro Ser Leu Pro | | |
| 180 | 185 | 190 |
| Pro Leu Pro Asp Thr Glu Ser Glu Ser Lys Glu Lys Lys Ser Leu Pro | | |
| 195 | 200 | 205 |
| Trp Gly Leu Ile Ser Leu Val Ile Phe Leu Leu Leu Ala Val Thr Gly | | |
| 210 | 215 | 220 |
| Val Phe Ala Ala Tyr Thr Tyr Leu Gly Leu Ile Ile Ala Glu Thr Ala | | |
| 225 | 230 | 235 |
| Gly Asp Ser Phe Val Ser Ile Gly Leu Phe Ala Phe Gly Ala Leu Gly | | |
| 245 | 250 | 255 |
| Leu Ile Gly Val Thr Val Ala Thr Arg Thr Val Asp Gln Arg Met Leu | | |
| 260 | 265 | 270 |
| Arg Gly Ser Val His Thr Thr Thr Leu Phe Val Ile Ala Ala Ile Leu | | |
| 275 | 280 | 285 |
| Gly Gln Ile Ala Phe Gly Leu Glu Gly Thr Leu Ala Val Val Ala Ile | | |
| 290 | 295 | 300 |
| Phe Leu Ala Val Thr Val Phe Gly Gly Ala Tyr Gly Ala Leu Pro Thr | | |
| 305 | 310 | 315 |
| Leu Gly Thr Thr Ile Phe Leu His Ala Gly Arg Asp His Pro Asp Thr | | |
| 325 | 330 | 335 |
| Ala Ser Ser Ile Tyr Val Val Thr Tyr Gln Val Gly Ile Ala Ser Gly | | |

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|
| 340 | | | | | | 345 | | | | | | 350 | | | | | |
| Ala | Ala | Leu | Gly | Ala | Met | Ala | Val | Asp | Ala | Asp | Trp | Val | Ala | Gly | Thr | | |
| 355 | | | | | | 360 | | | | | | 365 | | | | | |
| Leu | Trp | Ile | Met | Ala | Gly | Leu | Ser | Leu | Ala | Ser | Thr | Leu | Ala | Leu | Ala | | |
| 370 | | | | | | 375 | | | | | | 380 | | | | | |
| Leu | Trp | Ser | Arg | Pro | Leu | Leu | Lys | | | | | | | | | | |
| 385 | | | | | | 390 | | | | | | | | | | | |

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<210> 135
<211> 420
<212> DNA
<213> Corynebacterium glutamicum
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<220>  
<221> CDS  
<222> (101)..(397)  
<223> RXN01984
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| | | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <400> 135 | | | | | | | | | | | | | | | | |
| aggaaatgtc tcacgtcaca accttttgaa aggtggctaa gtacgcacat ttgttgtctg | | | | | | | | | | | | | | | | 60 |
| caatagtgcc ggtgagggag ctgtccgata ttgtgcttac | | | | | | | | | | | | | | | | |
| | | | | | | | | | | atg | cac | gaa | tct | gga | | 115 |
| | | | | | | | | | | Met | His | Glu | Ser | Gly | | |
| | | | | | | | | | | 1 | | | | 5 | | |
| aaa aat cct gtc aag gtt gtc gac tcg cag gca cca caa gga cgc ggt | | | | | | | | | | | | | | | | 163 |
| Lys | Asn | Pro | Val | Lys | Val | Val | Asp | Ser | Gln | Ala | Pro | Gln | Gly | Arg | Gly | |
| | | | | 10 | | | | | 15 | | | | | 20 | | |
| ggg cat atc ggc gga cat atc aaa cgc cgc ccg att cct agg caa acg | | | | | | | | | | | | | | | | 211 |
| Gly | His | Ile | Gly | Gly | His | Ile | Lys | Arg | Arg | Pro | Ile | Pro | Arg | Gln | Thr | |
| | | | 25 | | | | | 30 | | | | | 35 | | | |
| gaa att tcc gag gtt cgt cga tat atc gtc atg act gcc ctc gca ctc | | | | | | | | | | | | | | | | 259 |
| Glu | Ile | Ser | Glu | Val | Arg | Arg | Tyr | Ile | Val | Met | Thr | Ala | Leu | Ala | Leu | |
| | | | 40 | | | | 45 | | | | | 50 | | | | |
| ggg ggc ttc gcc atc ggt gtg acg gaa ttt gtc tcc atg ggt ctg ctc | | | | | | | | | | | | | | | | 307 |
| Gly | Gly | Phe | Ala | Ile | Gly | Val | Thr | Glu | Phe | Val | Ser | Met | Gly | Leu | Leu | |
| | | 55 | | | | 60 | | | | | 65 | | | | | |
| agc gcg atc gcc tcc gac ttt gag atc tcc gaa gac caa gcc gga cac | | | | | | | | | | | | | | | | 355 |
| Ser | Ala | Ile | Ala | Ser | Asp | Phe | Glu | Ile | Ser | Glu | Asp | Gln | Ala | Gly | His | |
| 70 | | | | | 75 | | | | | 80 | | | | 85 | | |
| atc atc acc atc tac gcc ctc gcg tgg ttg tgg gtg ccc cgc | | | | | | | | | | | | | | | | 397 |
| Ile | Ile | Thr | Ile | Tyr | Ala | Leu | Ala | Trp | Leu | Trp | Val | Pro | Arg | | | |
| | | | 90 | | | | 95 | | | | | | | | | |
| tgatcacagc gtttaccggc aaa | | | | | | | | | | | | | | | | 420 |

<210> 136

<211> 99
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 136

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | His | Glu | Ser | Gly | Lys | Asn | Pro | Val | Lys | Val | Val | Asp | Ser | Gln | Ala |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |
| Pro | Gln | Gly | Arg | Gly | Gly | His | Ile | Gly | Gly | His | Ile | Lys | Arg | Arg | Pro |
| | | | 20 | | | | | 25 | | | | | 30 | | |
| Ile | Pro | Arg | Gln | Thr | Glu | Ile | Ser | Glu | Val | Arg | Arg | Tyr | Ile | Val | Met |
| | | 35 | | | | 40 | | | | | | 45 | | | |
| Thr | Ala | Leu | Ala | Leu | Gly | Gly | Phe | Ala | Ile | Gly | Val | Thr | Glu | Phe | Val |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Ser | Met | Gly | Leu | Leu | Ser | Ala | Ile | Ala | Ser | Asp | Phe | Glu | Ile | Ser | Glu |
| | 65 | | | | 70 | | | | | 75 | | | | | 80 |
| Asp | Gln | Ala | Gly | His | Ile | Ile | Thr | Ile | Tyr | Ala | Leu | Ala | Trp | Leu | Trp |
| | | | | 85 | | | | | 90 | | | | | 95 | |

Val Pro Arg

<210> 137
 <211> 379
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(379)
 <223> FRXA01984

<400> 137

| | | | | | | |
|---|------------|------------|-------------|---------------------|------------|----|
| aggaaatgtc | tcacgtcaca | accttttgaa | aggtgggctaa | gtacgcacat | ttgttgtctg | 60 |
| caatagtgcc | ggtgagggag | ctgtccgata | ttgtgcttac | atg cac gaa tct gga | 115 | |
| | | | | Met His Glu Ser Gly | | |
| | | | | 1 | 5 | |
| aaa aat cct gtc aag gtt gtc gac tcg cag gca cca caa gga cgc ggt | 163 | | | | | |
| Lys Asn Pro Val Lys Val Val Asp Ser Gln Ala Pro Gln Gly Arg Gly | | | | | | |
| | 10 | | 15 | | 20 | |
| ggg cat atc ggc gga cat atc aaa cgc cgc ccg att cct agg caa acg | 211 | | | | | |
| Gly His Ile Gly Gly His Ile Lys Arg Arg Pro Ile Pro Arg Gln Thr | | | | | | |
| | 25 | | 30 | | 35 | |
| gaa att tcc gag gtt cgt cga tat atc gtc atg act gcc ctc gca ctc | 259 | | | | | |
| Glu Ile Ser Glu Val Arg Arg Tyr Ile Val Met Thr Ala Leu Ala Leu | | | | | | |
| | 40 | | 45 | | 50 | |
| ggg ggc ttc gcc atc ggt gtg acg gaa ttt gtc tcc atg ggt ctg ctc | 307 | | | | | |

Gly Gly Phe Ala Ile Gly Val Thr Glu Phe Val Ser Met Gly Leu Leu
 55 60 65

agc gcg atc gcc tcc gac ttt gag atc tcc gaa gac caa gcc gga cac 355
 Ser Ala Ile Ala Ser Asp Phe Glu Ile Ser Glu Asp Gln Ala Gly His
 70 75 80 85

atc atc acc atc tac gcc ctc gcg 379
 Ile Ile Thr Ile Tyr Ala Leu Ala
 90

<210> 138

<211> 93

<212> PRT

<213> Corynebacterium glutamicum

<400> 138

Met His Glu Ser Gly Lys Asn Pro Val Lys Val Val Asp Ser Gln Ala
 1 5 10 15

Pro Gln Gly Arg Gly Gly His Ile Gly Gly His Ile Lys Arg Arg Pro
 20 25 30

Ile Pro Arg Gln Thr Glu Ile Ser Glu Val Arg Arg Tyr Ile Val Met
 35 40 45

Thr Ala Leu Ala Leu Gly Gly Phe Ala Ile Gly Val Thr Glu Phe Val
 50 55 60

Ser Met Gly Leu Leu Ser Ala Ile Ala Ser Asp Phe Glu Ile Ser Glu
 65 70 75 80

Asp Gln Ala Gly His Ile Ile Thr Ile Tyr Ala Leu Ala
 85 90

<210> 139

<211> 735

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(712)

<223> RXA00109

<400> 139

aagtggggga agatttcgac aactaaccgg gcgcaaagat gaaactaatg cgtccgacca 60

cggcgaaaag gaagtttcgc ccatctatga gaggttgaat gtg gct tca gag aag 115
 Val Ala Ser Glu Lys
 1 5

aat cta aaa ttg cgt acc ttg gcg gca gct gct ggg gtg ttg ggc gtt 163
 Asn Leu Lys Leu Arg Thr Leu Ala Ala Ala Gly Val Leu Gly Val
 10 15 20

ggc gcg atg tcg atg ctc gtg gct ccg cag gct gct gcc cat gat gtg 211
 Gly Ala Met Ser Met Leu Val Ala Pro Gln Ala Ala Ala His Asp Val
 25 30 35

gtg gtg gat tct aat cct gaa aat ggc agt gtc gtt gat gag ttc ccg 259
 Val Val Asp Ser Asn Pro Glu Asn Gly Ser Val Val Asp Glu Phe Pro
 40 45 50

gag acc att gag ttg gag ttt tcc ggt att cct cag gat ctg ttc aca 307
 Glu Thr Ile Glu Leu Glu Phe Ser Gly Ile Pro Gln Asp Leu Phe Thr
 55 60 65

aca gtt gca ttg agc aat gcg gat tcc gga gag gtg tta act tct gga 355
 Thr Val Ala Leu Ser Asn Ala Asp Ser Gly Glu Val Leu Thr Ser Gly
 70 75 80 85

act cct cag ctt gag ggg cag cac ttg agc tat gaa gtg cca tct gat 403
 Thr Pro Gln Leu Glu Gly Gln His Leu Ser Tyr Glu Val Pro Ser Asp
 90 95 100

gtg cag acg gga gct ggt aac tac att ttg ggt ttc cag atc act tct 451
 Val Gln Thr Gly Ala Gly Asn Tyr Ile Leu Gly Phe Gln Ile Thr Ser
 105 110 115

tct gat ggt cac gct act aaa ggt tca atc tct ttt gag gtg aca ggc 499
 Ser Asp Gly His Ala Thr Lys Gly Ser Ile Ser Phe Glu Val Thr Gly
 120 125 130

tct gct gaa acg aca aca gag aca aca gca gag acg aca act gag tca 547
 Ser Ala Glu Thr Thr Thr Glu Thr Thr Ala Glu Thr Thr Thr Glu Ser
 135 140 145

gca gca acc act gac acc tca gag acc acc gaa gca gag aca act gaa 595
 Ala Ala Thr Thr Asp Thr Ser Glu Thr Thr Glu Ala Glu Thr Thr Glu
 150 155 160 165

act gct gat gaa act tct gga att cct gcg ccg tgg aat tgg gtt ttg 643
 Thr Ala Asp Glu Thr Ser Gly Ile Pro Ala Pro Trp Asn Trp Val Leu
 170 175 180

agc atc gtg gcg gtg ctt gtt gtt gca agt gcc atc gtc atg atg att 691
 Ser Ile Val Ala Val Leu Val Val Ala Ser Ala Ile Val Met Met Ile
 185 190 195

gca aag aat cgt aac cag aaa taagagggtt tattcaccat gaa 735
 Ala Lys Asn Arg Asn Gln Lys
 200

<210> 140

<211> 204

<212> PRT

<213> Corynebacterium glutamicum

<400> 140

Val Ala Ser Glu Lys Asn Leu Lys Leu Arg Thr Leu Ala Ala Ala Ala

| | | | |
|---|-----|-----|-----|
| 1 | 5 | 10 | 15 |
| Gly Val Leu Gly Val Gly Ala Met Ser Met Leu Val Ala Pro Gln Ala | 20 | 25 | 30 |
| Ala Ala His Asp Val Val Val Asp Ser Asn Pro Glu Asn Gly Ser Val | 35 | 40 | 45 |
| Val Asp Glu Phe Pro Glu Thr Ile Glu Leu Glu Phe Ser Gly Ile Pro | 50 | 55 | 60 |
| Gln Asp Leu Phe Thr Thr Val Ala Leu Ser Asn Ala Asp Ser Gly Glu | 65 | 70 | 75 |
| Val Leu Thr Ser Gly Thr Pro Gln Leu Glu Gly Gln His Leu Ser Tyr | 85 | 90 | 95 |
| Glu Val Pro Ser Asp Val Gln Thr Gly Ala Gly Asn Tyr Ile Leu Gly | 100 | 105 | 110 |
| Phe Gln Ile Thr Ser Ser Asp Gly His Ala Thr Lys Gly Ser Ile Ser | 115 | 120 | 125 |
| Phe Glu Val Thr Gly Ser Ala Glu Thr Thr Thr Glu Thr Thr Ala Glu | 130 | 135 | 140 |
| Thr Thr Thr Glu Ser Ala Ala Thr Thr Asp Thr Ser Glu Thr Thr Glu | 145 | 150 | 155 |
| Ala Glu Thr Thr Glu Thr Ala Asp Glu Thr Ser Gly Ile Pro Ala Pro | 165 | 170 | 175 |
| Trp Asn Trp Val Leu Ser Ile Val Ala Val Leu Val Val Ala Ser Ala | 180 | 185 | 190 |
| Ile Val Met Met Ile Ala Lys Asn Arg Asn Gln Lys | 195 | 200 | |

<210> 141
 <211> 735
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(712)
 <223> RXA00109

<400> 141
 aagtggggga agatttcgac aactaaccgg gcgcaaagat gaaactaatg cgtccgacca 60
 cggcgaaaag gaagtttcgc ccatctatga gaggttgaat gtg gct tca gag aag 115
 Val Ala Ser Glu Lys
 1 5
 aat cta aaa ttg cgt acc ttg gcg gca gct gct ggg gtg ttg ggc gtt 163

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Asn | Leu | Lys | Leu | Arg | Thr | Leu | Ala | Ala | Ala | Ala | Gly | Val | Leu | Gly | Val | | |
| | | | | 10 | | | | | 15 | | | | | 20 | | | |
| ggc | gcg | atg | tcg | atg | ctc | gtg | gct | ccg | cag | gct | gct | gcc | cat | gat | gtg | 211 | |
| Gly | Ala | Met | Ser | Met | Leu | Val | Ala | Pro | Gln | Ala | Ala | Ala | His | Asp | Val | | |
| | | | 25 | | | | | 30 | | | | | 35 | | | | |
| gtg | gtg | gat | tct | aat | cct | gaa | aat | ggc | agt | gtc | gtt | gat | gag | ttc | ccg | 259 | |
| Val | Val | Asp | Ser | Asn | Pro | Glu | Asn | Gly | Ser | Val | Val | Asp | Glu | Phe | Pro | | |
| | | 40 | | | | | 45 | | | | | 50 | | | | | |
| gag | acc | att | gag | ttg | gag | ttt | tcc | ggt | att | cct | cag | gat | ctg | ttc | aca | 307 | |
| Glu | Thr | Ile | Glu | Leu | Glu | Phe | Ser | Gly | Ile | Pro | Gln | Asp | Leu | Phe | Thr | | |
| | 55 | | | | | 60 | | | | | 65 | | | | | | |
| aca | gtt | gca | ttg | agc | aat | gcg | gat | tcc | gga | gag | gtg | tta | act | tct | gga | 355 | |
| Thr | Val | Ala | Leu | Ser | Asn | Ala | Asp | Ser | Gly | Glu | Val | Leu | Thr | Ser | Gly | | |
| | 70 | | | | 75 | | | | | 80 | | | | | 85 | | |
| act | cct | cag | ctt | gag | ggg | cag | cac | ttg | agc | tat | gaa | gtg | cca | tct | gat | 403 | |
| Thr | Pro | Gln | Leu | Glu | Gly | Gln | His | Leu | Ser | Tyr | Glu | Val | Pro | Ser | Asp | | |
| | | | 90 | | | | | | 95 | | | | | 100 | | | |
| gtg | cag | acg | gga | gct | ggt | aac | tac | att | ttg | ggt | ttc | cag | atc | act | tct | 451 | |
| Val | Gln | Thr | Gly | Ala | Gly | Asn | Tyr | Ile | Leu | Gly | Phe | Gln | Ile | Thr | Ser | | |
| | | | 105 | | | | | 110 | | | | | 115 | | | | |
| tct | gat | ggt | cac | gct | act | aaa | ggt | tca | atc | tct | ttt | gag | gtg | aca | ggc | 499 | |
| Ser | Asp | Gly | His | Ala | Thr | Lys | Gly | Ser | Ile | Ser | Phe | Glu | Val | Thr | Gly | | |
| | | 120 | | | | | 125 | | | | | 130 | | | | | |
| tct | gct | gaa | acg | aca | aca | gag | aca | aca | gca | gag | acg | aca | act | gag | tca | 547 | |
| Ser | Ala | Glu | Thr | Thr | Thr | Glu | Thr | Thr | Ala | Glu | Thr | Thr | Thr | Glu | Ser | | |
| | 135 | | | | | 140 | | | | | 145 | | | | | | |
| gca | gca | acc | act | gac | acc | tca | gag | acc | acc | gaa | gca | gag | aca | act | gaa | 595 | |
| Ala | Ala | Thr | Thr | Asp | Thr | Ser | Glu | Thr | Thr | Glu | Ala | Glu | Thr | Thr | Glu | | |
| | 150 | | | | 155 | | | | | 160 | | | | | 165 | | |
| act | gct | gat | gaa | act | tct | gga | att | cct | gcg | ccg | tgg | aat | tgg | gtt | ttg | 643 | |
| Thr | Ala | Asp | Glu | Thr | Ser | Gly | Ile | Pro | Ala | Pro | Trp | Asn | Trp | Val | Leu | | |
| | | | 170 | | | | | 175 | | | | | | 180 | | | |
| agc | atc | gtg | gcg | gtg | ctt | gtt | gtt | gca | agt | gcc | atc | gtc | atg | atg | att | 691 | |
| Ser | Ile | Val | Ala | Val | Leu | Val | Val | Ala | Ser | Ala | Ile | Val | Met | Met | Ile | | |
| | | 185 | | | | | 190 | | | | | 195 | | | | | |
| gca | aag | aat | cgt | aac | cag | aaa | taagagggtt | tattcaccat | gaa | | | | | | | 735 | |
| Ala | Lys | Asn | Arg | Asn | Gln | Lys | | | | | | | | | | | |
| | | 200 | | | | | | | | | | | | | | | |

<210> 142

<211> 204

<212> PRT

<213> Corynebacterium glutamicum

<400> 142

Val Ala Ser Glu Lys Asn Leu Lys Leu Arg Thr Leu Ala Ala Ala Ala
 1 5 10 15

Gly Val Leu Gly Val Gly Ala Met Ser Met Leu Val Ala Pro Gln Ala
 20 25 30

Ala Ala His Asp Val Val Val Asp Ser Asn Pro Glu Asn Gly Ser Val
 35 40 45

Val Asp Glu Phe Pro Glu Thr Ile Glu Leu Glu Phe Ser Gly Ile Pro
 50 55 60

Gln Asp Leu Phe Thr Thr Val Ala Leu Ser Asn Ala Asp Ser Gly Glu
 65 70 75 80

Val Leu Thr Ser Gly Thr Pro Gln Leu Glu Gly Gln His Leu Ser Tyr
 85 90 95

Glu Val Pro Ser Asp Val Gln Thr Gly Ala Gly Asn Tyr Ile Leu Gly
 100 105 110

Phe Gln Ile Thr Ser Ser Asp Gly His Ala Thr Lys Gly Ser Ile Ser
 115 120 125

Phe Glu Val Thr Gly Ser Ala Glu Thr Thr Thr Glu Thr Thr Ala Glu
 130 135 140

Thr Thr Thr Glu Ser Ala Ala Thr Thr Asp Thr Ser Glu Thr Thr Glu
 145 150 155 160

Ala Glu Thr Thr Glu Thr Ala Asp Glu Thr Ser Gly Ile Pro Ala Pro
 165 170 175

Trp Asn Trp Val Leu Ser Ile Val Ala Val Leu Val Val Ala Ser Ala
 180 185 190

Ile Val Met Met Ile Ala Lys Asn Arg Asn Gln Lys
 195 200

<210> 143

<211> 864

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(841)

<223> RXA00996

<400> 143

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acctctatct tgcacctgat ctggcgtaga ctcataagtt atg agc acc gta acg 115
 Met Ser Thr Val Thr
 1 5

| | |
|---|-----|
| gca gtg cag gtc aac ggc cta aaa gtt tcc ata tcg tcc ggt ttt tca | 163 |
| Ala Val Gln Val Asn Gly Leu Lys Val Ser Ile Ser Ser Gly Phe Ser | |
| 10 15 20 | |
| cgc aag aaa aca aaa acg atc ttg cat gat ctc gat ttc acc gta gag | 211 |
| Arg Lys Lys Thr Lys Thr Ile Leu His Asp Leu Asp Phe Thr Val Glu | |
| 25 30 35 | |
| acc gga aag atc acg gga ttg ctg ggg cca tcg ggc agc ggc aag aca | 259 |
| Thr Gly Lys Ile Thr Gly Leu Leu Gly Pro Ser Gly Ser Gly Lys Thr | |
| 40 45 50 | |
| act ttg atg cgc gcg att gtg gga gtg caa aac ttc gac ggc acc ctt | 307 |
| Thr Leu Met Arg Ala Ile Val Gly Val Gln Asn Phe Asp Gly Thr Leu | |
| 55 60 65 | |
| gag gtg ttt gat cag ccc gca ggt gct gcc tct ctg cgc ggg aaa atc | 355 |
| Glu Val Phe Asp Gln Pro Ala Gly Ala Ala Ser Leu Arg Gly Lys Ile | |
| 70 75 80 85 | |
| ggc tat gtc acc caa aac gcc agc gta tat cac gat ctg tcg gtg ata | 403 |
| Gly Tyr Val Thr Gln Asn Ala Ser Val Tyr His Asp Leu Ser Val Ile | |
| 90 95 100 | |
| gaa aac ctc aag tat ttc ggg gct ctg gct aaa gga acc tcc act cca | 451 |
| Glu Asn Leu Lys Tyr Phe Gly Ala Leu Ala Lys Gly Thr Ser Thr Pro | |
| 105 110 115 | |
| cgc acc ccg gaa aag att ctg gag gtc tta gac atc gca gat ctt gct | 499 |
| Arg Thr Pro Glu Lys Ile Leu Glu Val Leu Asp Ile Ala Asp Leu Ala | |
| 120 125 130 | |
| caa cgc caa gta tca aca cta tct ggt ggg cag cgc ggc cga gtc tcc | 547 |
| Gln Arg Gln Val Ser Thr Leu Ser Gly Gly Gln Arg Gly Arg Val Ser | |
| 135 140 145 | |
| ctt gga tgt gcg ctt att gcc tca cca gaa ctc ttg gtg atg gat gag | 595 |
| Leu Gly Cys Ala Leu Ile Ala Ser Pro Glu Leu Val Met Asp Glu | |
| 150 155 160 165 | |
| cca acc gtg ggt ttg gat ccc att acc cgg caa gca ctg tgg gaa gag | 643 |
| Pro Thr Val Gly Leu Asp Pro Ile Thr Arg Gln Ala Leu Trp Glu Glu | |
| 170 175 180 | |
| ttc acc acc atc gca aaa gca ggt gct gga gtg gtt atc tcc agt cac | 691 |
| Phe Thr Thr Ile Ala Lys Ala Gly Ala Gly Val Val Ile Ser Ser His | |
| 185 190 195 | |
| gtg ttg gag gaa gcc gcg cgg tgc gac aac ctc att ttg ttg cgt gat | 739 |
| Val Leu Glu Glu Ala Ala Arg Cys Asp Asn Leu Ile Leu Leu Arg Asp | |
| 200 205 210 | |
| ggt cgg atc atc tgg agg gga aca ccc aca cgc ctt cta gaa gat aca | 787 |
| Gly Arg Ile Ile Trp Arg Gly Thr Pro Thr Arg Leu Leu Glu Asp Thr | |
| 215 220 225 | |

ggc aaa agc tca tac gaa gat gct ttc ttg gct gcc att gac ggg gta 835
 Gly Lys Ser Ser Tyr Glu Asp Ala Phe Leu Ala Ala Ile Asp Gly Val
 230 235 240 245

agg tca tgaaccctca ctatctgctt gcc 864
 Arg Ser

<210> 144

<211> 247

<212> PRT

<213> Corynebacterium glutamicum

<400> 144

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Ser Ser Gly Phe Ser Arg Lys Lys Thr Lys Thr Ile Leu His Asp Leu
 20 25 30

Asp Phe Thr Val Glu Thr Gly Lys Ile Thr Gly Leu Leu Gly Pro Ser
 35 40 45

Gly Ser Gly Lys Thr Thr Leu Met Arg Ala Ile Val Gly Val Gln Asn
 50 55 60

Phe Asp Gly Thr Leu Glu Val Phe Asp Gln Pro Ala Gly Ala Ala Ser
 65 70 75 80

Leu Arg Gly Lys Ile Gly Tyr Val Thr Gln Asn Ala Ser Val Tyr His
 85 90 95

Asp Leu Ser Val Ile Glu Asn Leu Lys Tyr Phe Gly Ala Leu Ala Lys
 100 105 110

Gly Thr Ser Thr Pro Arg Thr Pro Glu Lys Ile Leu Glu Val Leu Asp
 115 120 125

Ile Ala Asp Leu Ala Gln Arg Gln Val Ser Thr Leu Ser Gly Gly Gln
 130 135 140

Arg Gly Arg Val Ser Leu Gly Cys Ala Leu Ile Ala Ser Pro Glu Leu
 145 150 155 160

Leu Val Met Asp Glu Pro Thr Val Gly Leu Asp Pro Ile Thr Arg Gln
 165 170 175

Ala Leu Trp Glu Glu Phe Thr Thr Ile Ala Lys Ala Gly Ala Gly Val
 180 185 190

Val Ile Ser Ser His Val Leu Glu Glu Ala Ala Arg Cys Asp Asn Leu
 195 200 205

Ile Leu Leu Arg Asp Gly Arg Ile Ile Trp Arg Gly Thr Pro Thr Arg
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Leu Leu Glu Asp Thr Gly Lys Ser Ser Tyr Glu Asp Ala Phe Leu Ala
 225 230 235 240

Ala Ile Asp Gly Val Arg Ser
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 <213> Corynebacterium glutamicum

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 <223> RXN00829

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 Met Gln Lys Ala Asp
 1 5
 tcc cat gat tgg att tcg gtc cac ggt gcg aat gaa aac aac ctc aaa 163
 Ser His Asp Trp Ile Ser Val His Gly Ala Asn Glu Asn Asn Leu Lys
 10 15 20
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 Asn Val Ser Val Arg Ile Pro Lys Arg Arg Leu Thr Val Phe Thr Gly
 25 30 35
 gtg tcg gga tct ggc aag tcc tcg ctg gtg ttc ggc aca att gct gcg 259
 Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe Gly Thr Ile Ala Ala
 40 45 50
 gaa tca cgc cgg ttg atc aac gaa acc tat agc act ttt gtg caa ggt 307
 Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser Thr Phe Val Gln Gly
 55 60 65
 ttc atg ccg tcg atg gca agg ccc gat gtt gac cat ttg gaa ggc atc 355
 Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp His Leu Glu Gly Ile
 70 75 80 85
 acc acg gcg atc atc gtc gat cag gag cag atg ggc gca aac cca cgg 403
 Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met Gly Ala Asn Pro Arg
 90 95 100
 tct acg gtg ggt acc gca act gat gcc acc gcg atg ttg cgc att ttg 451
 Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala Met Leu Arg Ile Leu
 105 110 115
 ttt tcc cga atc gcg gaa cct aac gcg ggt ggc ccg gga gct tat tcc 499
 Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly Pro Gly Ala Tyr Ser
 120 125 130
 ttc aac gtc ccc tct gtt tcc gca tcc ggc gcc atc acg gtg gaa aag 547

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| Phe | Asn | Val | Pro | Ser | Val | Ser | Ala | Ser | Gly | Ala | Ile | Thr | Val | Glu | Lys | | |
| 135 | | | | | | 140 | | | | | 145 | | | | | | |
| ggc | gga | aac | acc | aag | cgg | gag | aaa | gct | acc | ttc | aaa | cgc | acg | ggt | ggc | 595 | |
| Gly | Gly | Asn | Thr | Lys | Arg | Glu | Lys | Ala | Thr | Phe | Lys | Arg | Thr | Gly | Gly | | |
| 150 | | | | | 155 | | | | | 160 | | | | | 165 | | |
| atg | tgc | cca | gcg | tgc | gag | ggc | atg | ggc | agg | gcc | tca | gac | atc | gac | ctc | 643 | |
| Met | Cys | Pro | Ala | Cys | Glu | Gly | Met | Gly | Arg | Ala | Ser | Asp | Ile | Asp | Leu | | |
| | | | | 170 | | | | | 175 | | | | | 180 | | | |
| aaa | gag | ctt | ttc | gac | gcc | tcc | ctc | tcc | ctc | aac | gac | ggc | gcc | ctg | acc | 691 | |
| Lys | Glu | Leu | Phe | Asp | Ala | Ser | Leu | Ser | Leu | Asn | Asp | Gly | Ala | Leu | Thr | | |
| | | | 185 | | | | | 190 | | | | | 195 | | | | |
| atc | ccc | ggt | tac | acc | cca | ggt | gga | tgg | agt | tat | cgg | atg | tat | tca | gaa | 739 | |
| Ile | Pro | Gly | Tyr | Thr | Pro | Gly | Gly | Trp | Ser | Tyr | Arg | Met | Tyr | Ser | Glu | | |
| | | 200 | | | | | 205 | | | | | 210 | | | | | |
| tcg | ggc | ctt | ttt | gat | gct | gcc | aag | ccg | att | aag | gat | ttc | acc | gag | gaa | 787 | |
| Ser | Gly | Leu | Phe | Asp | Ala | Ala | Lys | Pro | Ile | Lys | Asp | Phe | Thr | Glu | Glu | | |
| | 215 | | | | | 220 | | | | | 225 | | | | | | |
| gaa | cgc | cac | aac | ttc | ctt | tat | ctt | gag | ccc | acc | aag | atg | aag | atc | gct | 835 | |
| Glu | Arg | His | Asn | Phe | Leu | Tyr | Leu | Glu | Pro | Thr | Lys | Met | Lys | Ile | Ala | | |
| 230 | | | | | 235 | | | | | 240 | | | | | 245 | | |
| ggc | atc | aac | atg | acc | tat | gag | ggt | ctt | atc | ccc | cgc | att | cag | aaa | tcc | 883 | |
| Gly | Ile | Asn | Met | Thr | Tyr | Glu | Gly | Leu | Ile | Pro | Arg | Ile | Gln | Lys | Ser | | |
| | | | | 250 | | | | | 255 | | | | | 260 | | | |
| atg | ttg | tct | aag | gat | cgc | gaa | ggc | atg | cag | aag | cat | att | cgt | gcg | ttc | 931 | |
| Met | Leu | Ser | Lys | Asp | Arg | Glu | Gly | Met | Gln | Lys | His | Ile | Arg | Ala | Phe | | |
| | | | 265 | | | | | 270 | | | | | 275 | | | | |
| gtg | gat | cga | gcg | ggt | acc | ttc | att | cct | tgc | cct | gcg | tgt | ggt | gga | act | 979 | |
| Val | Asp | Arg | Ala | Val | Thr | Phe | Ile | Pro | Cys | Pro | Ala | Cys | Gly | Gly | Thr | | |
| | | 280 | | | | | 285 | | | | | 290 | | | | | |
| cga | tta | gcg | cca | cat | gcc | ttg | gag | tcc | aag | atc | aat | ggc | aaa | aac | atc | 1027 | |
| Arg | Leu | Ala | Pro | His | Ala | Leu | Glu | Ser | Lys | Ile | Asn | Gly | Lys | Asn | Ile | | |
| | 295 | | | | | 300 | | | | | 305 | | | | | | |
| gct | gag | ttg | tgc | gcg | atg | gag | gtc | cgt | gat | ttg | gcc | aag | tgg | atc | aaa | 1075 | |
| Ala | Glu | Leu | Cys | Ala | Met | Glu | Val | Arg | Asp | Leu | Ala | Lys | Trp | Ile | Lys | | |
| 310 | | | | | 315 | | | | | 320 | | | | | 325 | | |
| acg | gtg | gaa | gcc | ccc | tcg | ggt | gct | ccc | ctg | ctc | acc | gca | ctg | act | gaa | 1123 | |
| Thr | Val | Glu | Ala | Pro | Ser | Val | Ala | Pro | Leu | Leu | Thr | Ala | Leu | Thr | Glu | | |
| | | | | 330 | | | | | 335 | | | | | 340 | | | |
| acc | ctg | gat | aac | ttc | gtg | gag | atc | ggt | ttg | ggc | tat | atc | caa | ctc | gat | 1171 | |
| Thr | Leu | Asp | Asn | Phe | Val | Glu | Ile | Gly | Leu | Gly | Tyr | Ile | Gln | Leu | Asp | | |
| | | | 345 | | | | | 350 | | | | | 355 | | | | |
| cgc | ccc | gct | ggc | acg | ttg | tct | ggt | ggt | gag | gca | cag | cgc | acc | aag | atg | 1219 | |
| Arg | Pro | Ala | Gly | Thr | Leu | Ser | Gly | Gly | Glu | Ala | Gln | Arg | Thr | Lys | Met | | |

| 360 | 365 | 370 | |
|---|-----|-----|------|
| atc cgc cat ttg ggc tct gca ttg act gac gtc acc tat gtt ttt gat Ile Arg His Leu Gly Ser Ala Leu Thr Asp Val Thr Tyr Val Phe Asp 375 380 385 | | | 1267 |
| gaa ccc acc gcc ggt ttg cac gcc tac gac att gaa cgc atg aac aag Glu Pro Thr Ala Gly Leu His Ala Tyr Asp Ile Glu Arg Met Asn Lys 390 395 400 405 | | | 1315 |
| ttg ctg ctc gat ctt cgc gat aaa ggc aat acc gtt tta gtc gtg gag Leu Leu Leu Asp Leu Arg Asp Lys Gly Asn Thr Val Leu Val Val Glu 410 415 420 | | | 1363 |
| cac aag ccg gaa acc atc gcc att gca gat cat gtg gtg gac ctt ggg His Lys Pro Glu Thr Ile Ala Ile Ala Asp His Val Val Asp Leu Gly 425 430 435 | | | 1411 |
| cca ggt gca ggc gcg ggt gga ggt gaa att cgg ttt gag ggg agc gtc Pro Gly Ala Gly Ala Gly Gly Gly Glu Ile Arg Phe Glu Gly Ser Val 440 445 450 | | | 1459 |
| gac aag ctt aaa gac agc gac acc gtg act ggc ctc cat ttt aat gac Asp Lys Leu Lys Asp Ser Asp Thr Val Thr Gly Leu His Phe Asn Asp 455 460 465 | | | 1507 |
| cgg gcg tca ttg aag gaa tcc gtg cgt gcg ccg cat ggc gcc ctg gag Arg Ala Ser Leu Lys Glu Ser Val Arg Ala Pro His Gly Ala Leu Glu 470 475 480 485 | | | 1555 |
| atc cgc ggg gcc gat cga aat aat ttg aac aat gtg gat gtc gat att Ile Arg Gly Ala Asp Arg Asn Asn Leu Asn Asn Val Asp Val Asp Ile 490 495 500 | | | 1603 |
| ccg ctc ggc gtg ttc acg gcg att tcc ggc gtt gca ggt tcg ggt aag Pro Leu Gly Val Phe Thr Ala Ile Ser Gly Val Ala Gly Ser Gly Lys 505 510 515 | | | 1651 |
| tcc tcg ttg att cat gag att ccg cgt gat gag tcg gtt gtg ttt gtc Ser Ser Leu Ile His Glu Ile Pro Arg Asp Glu Ser Val Val Phe Val 520 525 530 | | | 1699 |
| gat caa acc gca atc cac ggt tct aat cgt tcc aat cct gcg aca tat Asp Gln Thr Ala Ile His Gly Ser Asn Arg Ser Asn Pro Ala Thr Tyr 535 540 545 | | | 1747 |
| aca ggc atg ctg gat tcg att cgc aag gct ttt gcc aag gcc aat gat Thr Gly Met Leu Asp Ser Ile Arg Lys Ala Phe Ala Lys Ala Asn Asp 550 555 560 565 | | | 1795 |
| gtg aaa ccg gcg ctg ttc tcc ccc aat tct gaa ggc gcg tgc cca aac Val Lys Pro Ala Leu Phe Ser Pro Asn Ser Glu Gly Ala Cys Pro Asn 570 575 580 | | | 1843 |
| tgt aag ggc gcc ggc tcg gtc tat gtc gat ttg ggc atg atg gct ggg Cys Lys Gly Ala Gly Ser Val Tyr Val Asp Leu Gly Met Met Ala Gly 585 590 595 | | | 1891 |

gta tct tcg ccg tgt gag gtg tgc gag ggc aag cgt ttt gat gag tcc 1939
 Val Ser Ser Pro Cys Glu Val Cys Glu Gly Lys Arg Phe Asp Glu Ser
 600 605 610

gtg ttg gac tac cac ttt ggt ggc aag gac atc gca gac gtg ttg ggg 1987
 Val Leu Asp Tyr His Phe Gly Gly Lys Asp Ile Ala Asp Val Leu Gly
 615 620 625

ctg tcg gct gcc aat gcg tat gag ttt ttc gcg gcg aaa gat tca aag 2035
 Leu Ser Ala Ala Asn Ala Tyr Glu Phe Phe Ala Ala Lys Asp Ser Lys
 630 635 640 645

att ttg cct gcg gca aag atc gca aag agg ctt gtc gac gtc ggc ctc 2083
 Ile Leu Pro Ala Ala Lys Ile Ala Lys Arg Leu Val Asp Val Gly Leu
 650 655 660

ggc tac atc acc ctc ggc cag ccg ctc acc acg ttg tcc ggc ggt gaa 2131
 Gly Tyr Ile Thr Leu Gly Gln Pro Leu Thr Thr Leu Ser Gly Gly Glu
 665 670 675

cgc cag cgt ttg aag ctc gcc acc cac atg gca gac aag gcc acc acc 2179
 Arg Gln Arg Leu Lys Leu Ala Thr His Met Ala Asp Lys Ala Thr Thr
 680 685 690

ttt att ttg gat gag ccc acc aca ggc ctg cac ctc gct gat gtg aaa 2227
 Phe Ile Leu Asp Glu Pro Thr Thr Gly Leu His Leu Ala Asp Val Lys
 695 700 705

acc ttg ctg gat ctt ttt gat caa ctg gtt gat gac ggc aag tct gtc 2275
 Thr Leu Leu Asp Leu Phe Asp Gln Leu Val Asp Asp Gly Lys Ser Val
 710 715 720 725

atc gtc atc gaa cac cac ctc ggc gtg ctc gct cac gct gac cac atc 2323
 Ile Val Ile Glu His His Leu Gly Val Leu Ala His Ala Asp His Ile
 730 735 740

att gat gtc ggc cct ggt gca ggt tct gat ggt ggc tcg att gta ttc 2371
 Ile Asp Val Gly Pro Gly Ala Gly Ser Asp Gly Gly Ser Ile Val Phe
 745 750 755

gag ggc agc ccc gcg gaa ctc atc aaa act gat act cca aca gga cgc 2419
 Glu Gly Ser Pro Ala Glu Leu Ile Lys Thr Asp Thr Pro Thr Gly Arg
 760 765 770

cac ctt aaa gct tat gta gat tagttttctta tggaaaaccc tgg 2463
 His Leu Lys Ala Tyr Val Asp
 775 780

<210> 146

<211> 780

<212> PRT

<213> Corynebacterium glutamicum

<400> 146

Met Gln Lys Ala Asp Ser His Asp Trp Ile Ser Val His Gly Ala Asn

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| Glu Asn Asn Leu Lys Asn Val Ser Val Arg Ile Pro Lys Arg Arg Leu | 20 | 25 | 30 |
| Thr Val Phe Thr Gly Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe | 35 | 40 | 45 |
| Gly Thr Ile Ala Ala Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser | 50 | 55 | 60 |
| Thr Phe Val Gln Gly Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp | 65 | 70 | 75 |
| His Leu Glu Gly Ile Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met | 85 | 90 | 95 |
| Gly Ala Asn Pro Arg Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala | 100 | 105 | 110 |
| Met Leu Arg Ile Leu Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly | 115 | 120 | 125 |
| Pro Gly Ala Tyr Ser Phe Asn Val Pro Ser Val Ser Ala Ser Gly Ala | 130 | 135 | 140 |
| Ile Thr Val Glu Lys Gly Gly Asn Thr Lys Arg Glu Lys Ala Thr Phe | 145 | 150 | 155 |
| Lys Arg Thr Gly Gly Met Cys Pro Ala Cys Glu Gly Met Gly Arg Ala | 165 | 170 | 175 |
| Ser Asp Ile Asp Leu Lys Glu Leu Phe Asp Ala Ser Leu Ser Leu Asn | 180 | 185 | 190 |
| Asp Gly Ala Leu Thr Ile Pro Gly Tyr Thr Pro Gly Gly Trp Ser Tyr | 195 | 200 | 205 |
| Arg Met Tyr Ser Glu Ser Gly Leu Phe Asp Ala Ala Lys Pro Ile Lys | 210 | 215 | 220 |
| Asp Phe Thr Glu Glu Glu Arg His Asn Phe Leu Tyr Leu Glu Pro Thr | 225 | 230 | 235 |
| Lys Met Lys Ile Ala Gly Ile Asn Met Thr Tyr Glu Gly Leu Ile Pro | 245 | 250 | 255 |
| Arg Ile Gln Lys Ser Met Leu Ser Lys Asp Arg Glu Gly Met Gln Lys | 260 | 265 | 270 |
| His Ile Arg Ala Phe Val Asp Arg Ala Val Thr Phe Ile Pro Cys Pro | 275 | 280 | 285 |
| Ala Cys Gly Gly Thr Arg Leu Ala Pro His Ala Leu Glu Ser Lys Ile | 290 | 295 | 300 |
| Asn Gly Lys Asn Ile Ala Glu Leu Cys Ala Met Glu Val Arg Asp Leu | | | |

| | | | |
|-----------------|---------------------|-----------------|-----------------|
| 305 | 310 | 315 | 320 |
| Ala Lys Trp Ile | Lys Thr Val Glu Ala | Pro Ser Val Ala | Pro Leu Leu |
| | 325 | 330 | 335 |
| Thr Ala Leu Thr | Glu Thr Leu Asp | Asn Phe Val Glu | Ile Gly Leu Gly |
| | 340 | 345 | 350 |
| Tyr Ile Gln Leu | Asp Arg Pro Ala | Gly Thr Leu Ser | Gly Gly Glu Ala |
| | 355 | 360 | 365 |
| Gln Arg Thr Lys | Met Ile Arg His | Leu Gly Ser Ala | Leu Thr Asp Val |
| | 370 | 375 | 380 |
| Thr Tyr Val Phe | Asp Glu Pro Thr | Ala Gly Leu His | Ala Tyr Asp Ile |
| | 385 | 390 | 395 |
| Glu Arg Met Asn | Lys Leu Leu Leu | Asp Leu Arg Asp | Lys Gly Asn Thr |
| | 405 | 410 | 415 |
| Val Leu Val Val | Glu His Lys Pro | Glu Thr Ile Ala | Ile Ala Asp His |
| | 420 | 425 | 430 |
| Val Val Asp Leu | Gly Pro Gly Ala | Gly Ala Gly Gly | Gly Glu Ile Arg |
| | 435 | 440 | 445 |
| Phe Glu Gly Ser | Val Asp Lys Leu | Lys Asp Ser Asp | Thr Val Thr Gly |
| | 450 | 455 | 460 |
| Leu His Phe Asn | Asp Arg Ala Ser | Leu Lys Glu Ser | Val Arg Ala Pro |
| | 465 | 470 | 475 |
| His Gly Ala Leu | Glu Ile Arg Gly | Ala Asp Arg Asn | Asn Leu Asn Asn |
| | 485 | 490 | 495 |
| Val Asp Val Asp | Ile Pro Leu Gly | Val Phe Thr Ala | Ile Ser Gly Val |
| | 500 | 505 | 510 |
| Ala Gly Ser Gly | Lys Ser Ser Leu | Ile His Glu Ile | Pro Arg Asp Glu |
| | 515 | 520 | 525 |
| Ser Val Val Phe | Val Asp Gln Thr | Ala Ile His Gly | Ser Asn Arg Ser |
| | 530 | 535 | 540 |
| Asn Pro Ala Thr | Tyr Thr Gly Met | Leu Asp Ser Ile | Arg Lys Ala Phe |
| | 545 | 550 | 555 |
| Ala Lys Ala Asn | Asp Val Lys Pro | Ala Leu Phe Ser | Pro Asn Ser Glu |
| | 565 | 570 | 575 |
| Gly Ala Cys Pro | Asn Cys Lys Gly | Ala Gly Ser Val | Tyr Val Asp Leu |
| | 580 | 585 | 590 |
| Gly Met Met Ala | Gly Val Ser Ser | Pro Cys Glu Val | Cys Glu Gly Lys |
| | 595 | 600 | 605 |
| Arg Phe Asp Glu | Ser Val Leu Asp | Tyr His Phe Gly | Gly Lys Asp Ile |

| 610 | 615 | 620 |
|--|-----|-----|
| Ala Asp Val Leu Gly Leu Ser Ala Ala Asn Ala Tyr Glu Phe Phe Ala 625 630 635 640 | | |
| Ala Lys Asp Ser Lys Ile Leu Pro Ala Ala Lys Ile Ala Lys Arg Leu 645 650 655 | | |
| Val Asp Val Gly Leu Gly Tyr Ile Thr Leu Gly Gln Pro Leu Thr Thr 660 665 670 | | |
| Leu Ser Gly Gly Glu Arg Gln Arg Leu Lys Leu Ala Thr His Met Ala 675 680 685 | | |
| Asp Lys Ala Thr Thr Phe Ile Leu Asp Glu Pro Thr Thr Gly Leu His 690 695 700 | | |
| Leu Ala Asp Val Lys Thr Leu Leu Asp Leu Phe Asp Gln Leu Val Asp 705 710 715 720 | | |
| Asp Gly Lys Ser Val Ile Val Ile Glu His His Leu Gly Val Leu Ala 725 730 735 | | |
| His Ala Asp His Ile Ile Asp Val Gly Pro Gly Ala Gly Ser Asp Gly 740 745 750 | | |
| Gly Ser Ile Val Phe Glu Gly Ser Pro Ala Glu Leu Ile Lys Thr Asp 755 760 765 | | |
| Thr Pro Thr Gly Arg His Leu Lys Ala Tyr Val Asp 770 775 780 | | |

<210> 147
 <211> 278
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (1)..(255)
 <223> FRXA00829

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| ctg gat ctt ttt gat caa ctg gtt gat gac ggc aag tct gtc atc gtc Leu Asp Leu Phe Asp Gln Leu Val Asp Asp Gly Lys Ser Val Ile Val 20 25 30 | 96 |
| atc gaa cac cac ctc ggc gtg ctc gct cac gct gac cac atc att gat Ile Glu His His Leu Gly Val Leu Ala His Ala Asp His Ile Ile Asp 35 40 45 | 144 |
| gtc ggc cct ggt gca ggt tct gat ggt ggc tcg att gta ttc gag ggc | 192 |

Val Gly Pro Gly Ala Gly Ser Asp Gly Gly Ser Ile Val Phe Glu Gly
50 55 60

agc ccc gcg gaa ctc atc aaa act gat act cca aca gga cgc cac ctt 240
Ser Pro Ala Glu Leu Ile Lys Thr Asp Thr Pro Thr Gly Arg His Leu
65 70 75 80

aaa gct tat gta gat tagtttctta tggaaaaccc tgg 278
Lys Ala Tyr Val Asp
85

<210> 148

<211> 85

<212> PRT

<213> Corynebacterium glutamicum

<400> 148

Leu Asp Glu Pro Thr Thr Gly Leu His Leu Ala Asp Val Lys Thr Leu
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Leu Asp Leu Phe Asp Gln Leu Val Asp Asp Gly Lys Ser Val Ile Val
20 25 30

Ile Glu His His Leu Gly Val Leu Ala His Ala Asp His Ile Ile Asp
35 40 45

Val Gly Pro Gly Ala Gly Ser Asp Gly Gly Ser Ile Val Phe Glu Gly
50 55 60

Ser Pro Ala Glu Leu Ile Lys Thr Asp Thr Pro Thr Gly Arg His Leu
65 70 75 80

Lys Ala Tyr Val Asp
85

<210> 149

<211> 1663

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1663)

<223> FRXA00834

<400> 149

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caagcgcgaa caggcctatg caaacggtac gatatgacac atg caa aaa gct gat 115
Met Gln Lys Ala Asp
1 5

tcc cat gat tgg att tcg gtc cac ggt gcg aat gaa aac aac ctc aaa 163
Ser His Asp Trp Ile Ser Val His Gly Ala Asn Glu Asn Asn Leu Lys
10 15 20

| | |
|---|-----|
| aat gtg tcg gtg cgc atc cct aaa agg cgt ctc acc gtg ttc acg ggt | 211 |
| Asn Val Ser Val Arg Ile Pro Lys Arg Arg Leu Thr Val Phe Thr Gly | |
| 25 30 35 | |
| gtg tcg gga tct ggc aag tcc tcg ctg gtg ttc ggc aca att gct gcg | 259 |
| Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe Gly Thr Ile Ala Ala | |
| 40 45 50 | |
| gaa tca cgc cgg ttg atc aac gaa acc tat agc act ttt gtg caa ggt | 307 |
| Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser Thr Phe Val Gln Gly | |
| 55 60 65 | |
| ttc atg ccg tcg atg gca agg ccc gat gtt gac cat ttg gaa ggc atc | 355 |
| Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp His Leu Glu Gly Ile | |
| 70 75 80 85 | |
| acc acg gcg atc atc gtc gat cag gag cag atg ggc gca aac cca cgg | 403 |
| Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met Gly Ala Asn Pro Arg | |
| 90 95 100 | |
| tct acg gtg ggt acc gca act gat gcc acc gcg atg ttg cgc att ttg | 451 |
| Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala Met Leu Arg Ile Leu | |
| 105 110 115 | |
| ttt tcc cga atc gcg gaa cct aac gcg ggt ggc ccg gga gct tat tcc | 499 |
| Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly Pro Gly Ala Tyr Ser | |
| 120 125 130 | |
| ttc aac gtc ccc tct gtt tcc gca tcc ggc gcc atc acg gtg gaa aag | 547 |
| Phe Asn Val Pro Ser Val Ser Ala Ser Gly Ala Ile Thr Val Glu Lys | |
| 135 140 145 | |
| ggc gga aac acc aag cgg gag aaa gct acc ttc aaa cgc acg ggt ggc | 595 |
| Gly Gly Asn Thr Lys Arg Glu Lys Ala Thr Phe Lys Arg Thr Gly Gly | |
| 150 155 160 165 | |
| atg tgc cca gcg tgc gag ggc atg ggc agg gcc tca gac atc gac ctc | 643 |
| Met Cys Pro Ala Cys Glu Gly Met Gly Arg Ala Ser Asp Ile Asp Leu | |
| 170 175 180 | |
| aaa gag ctt ttc gac gcc tcc ctc tcc ctc aac gac ggc gcc ctg acc | 691 |
| Lys Glu Leu Phe Asp Ala Ser Leu Ser Leu Asn Asp Gly Ala Leu Thr | |
| 185 190 195 | |
| atc ccc ggt tac acc cca ggt gga tgg agt tat cgg atg tat tca gaa | 739 |
| Ile Pro Gly Tyr Thr Pro Gly Gly Trp Ser Tyr Arg Met Tyr Ser Glu | |
| 200 205 210 | |
| tcg ggc ctt ttt gat gct gcc aag ccg att aag gat ttc acc gag gaa | 787 |
| Ser Gly Leu Phe Asp Ala Ala Lys Pro Ile Lys Asp Phe Thr Glu Glu | |
| 215 220 225 | |
| gaa cgc cac aac ttc ctt tat ctt gag ccc acc aag atg aag atc gct | 835 |
| Glu Arg His Asn Phe Leu Tyr Leu Glu Pro Thr Lys Met Lys Ile Ala | |
| 230 235 240 245 | |

| | |
|---|------|
| ggc atc aac atg acc tat gag ggt ctt atc ccc cgc att cag aaa tcc | 883 |
| Gly Ile Asn Met Thr Tyr Glu Gly Leu Ile Pro Arg Ile Gln Lys Ser | |
| 250 255 260 | |
| atg ttg tct aag gat cgc gaa ggc atg cag aag cat att cgt gcg ttc | 931 |
| Met Leu Ser Lys Asp Arg Glu Gly Met Gln Lys His Ile Arg Ala Phe | |
| 265 270 275 | |
| gtg gat cga gcg gtt acc ttc att cct tgc cct gcg tgt ggt gga act | 979 |
| Val Asp Arg Ala Val Thr Phe Ile Pro Cys Pro Ala Cys Gly Gly Thr | |
| 280 285 290 | |
| cga tta gcg cca cat gcc ttg gag tcc aag atc aat ggc aaa aac atc | 1027 |
| Arg Leu Ala Pro His Ala Leu Glu Ser Lys Ile Asn Gly Lys Asn Ile | |
| 295 300 305 | |
| gct gag ttg tgc gcg atg gag gtc cgt gat ttg gcc aag tgg atc aaa | 1075 |
| Ala Glu Leu Cys Ala Met Glu Val Arg Asp Leu Ala Lys Trp Ile Lys | |
| 310 315 320 325 | |
| acg gtg gaa gcc ccc tcg gtt gct ccc ctg ctc acc gca ctg act gaa | 1123 |
| Thr Val Glu Ala Pro Ser Val Ala Pro Leu Leu Thr Ala Leu Thr Glu | |
| 330 335 340 | |
| acc ctg gat aac ttc gtg gag atc ggt ttg ggc tat atc caa ctc gat | 1171 |
| Thr Leu Asp Asn Phe Val Glu Ile Gly Leu Gly Tyr Ile Gln Leu Asp | |
| 345 350 355 | |
| cgc ccc gct ggc acg ttg tct ggt ggt gag gca cag cgc acc aag atg | 1219 |
| Arg Pro Ala Gly Thr Leu Ser Gly Gly Glu Ala Gln Arg Thr Lys Met | |
| 360 365 370 | |
| atc cgc cat ttg ggc tct gca ttg act gac gtc acc tat gtt ttt gat | 1267 |
| Ile Arg His Leu Gly Ser Ala Leu Thr Asp Val Thr Tyr Val Phe Asp | |
| 375 380 385 | |
| gaa ccc acc gcc ggt ttg cac gcc tac gac att gaa cgc atg aac aag | 1315 |
| Glu Pro Thr Ala Gly Leu His Ala Tyr Asp Ile Glu Arg Met Asn Lys | |
| 390 395 400 405 | |
| ttg ctg ctc gat ctt cgc gat aaa ggc aat acc gtt tta gtc gtg gag | 1363 |
| Leu Leu Leu Asp Leu Arg Asp Lys Gly Asn Thr Val Leu Val Val Glu | |
| 410 415 420 | |
| cac aag ccg gaa acc atc gcc att gca gat cat gtg gtg gac ctt ggg | 1411 |
| His Lys Pro Glu Thr Ile Ala Ile Ala Asp His Val Val Asp Leu Gly | |
| 425 430 435 | |
| cca ggt gca ggc gcg ggt gga ggt gaa att cgg ttt gag ggg agc gtc | 1459 |
| Pro Gly Ala Gly Ala Gly Gly Gly Glu Ile Arg Phe Glu Gly Ser Val | |
| 440 445 450 | |
| gac aag ctt aaa gac agc gac acc gtg act ggc ctc cat ttt aat gac | 1507 |
| Asp Lys Leu Lys Asp Ser Asp Thr Val Thr Gly Leu His Phe Asn Asp | |
| 455 460 465 | |
| cgg gcg tca ttg aag gaa tcc gtg cgt gcg ccg cat ggc gcc ctg gag | 1555 |

Arg Ala Ser Leu Lys Glu Ser Val Arg Ala Pro His Gly Ala Leu Glu
 470 475 480 485
 atc cgc ggg gcc gat cga aat aat ttg aac aat gtg gat gtc gat att 1603
 Ile Arg Gly Ala Asp Arg Asn Asn Leu Asn Asn Val Asp Val Asp Ile
 490 495 500
 ccg ctc ggc gtg ttc acg gcg att tcc ggc gtt gca ggt tcg ggt aag 1651
 Pro Leu Gly Val Phe Thr Ala Ile Ser Gly Val Ala Gly Ser Gly Lys
 505 510 515
 tcc tcg ttg att
 Ser Ser Leu Ile 1663
 520
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 <212> PRT
 <213> Corynebacterium glutamicum
 <400> 150
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 Glu Asn Asn Leu Lys Asn Val Ser Val Arg Ile Pro Lys Arg Arg Leu
 20 25 30
 Thr Val Phe Thr Gly Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe
 35 40 45
 Gly Thr Ile Ala Ala Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser
 50 55 60
 Thr Phe Val Gln Gly Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp
 65 70 75 80
 His Leu Glu Gly Ile Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met
 85 90 95
 Gly Ala Asn Pro Arg Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala
 100 105 110
 Met Leu Arg Ile Leu Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly
 115 120 125
 Pro Gly Ala Tyr Ser Phe Asn Val Pro Ser Val Ser Ala Ser Gly Ala
 130 135 140
 Ile Thr Val Glu Lys Gly Gly Asn Thr Lys Arg Glu Lys Ala Thr Phe
 145 150 155 160
 Lys Arg Thr Gly Gly Met Cys Pro Ala Cys Glu Gly Met Gly Arg Ala
 165 170 175
 Ser Asp Ile Asp Leu Lys Glu Leu Phe Asp Ala Ser Leu Ser Leu Asn
 180 185 190

Asp Gly Ala Leu Thr Ile Pro Gly Tyr Thr Pro Gly Gly Trp Ser Tyr
 195 200 205
 Arg Met Tyr Ser Glu Ser Gly Leu Phe Asp Ala Ala Lys Pro Ile Lys
 210 215 220
 Asp Phe Thr Glu Glu Glu Arg His Asn Phe Leu Tyr Leu Glu Pro Thr
 225 230 235 240
 Lys Met Lys Ile Ala Gly Ile Asn Met Thr Tyr Glu Gly Leu Ile Pro
 245 250 255
 Arg Ile Gln Lys Ser Met Leu Ser Lys Asp Arg Glu Gly Met Gln Lys
 260 265 270
 His Ile Arg Ala Phe Val Asp Arg Ala Val Thr Phe Ile Pro Cys Pro
 275 280 285
 Ala Cys Gly Gly Thr Arg Leu Ala Pro His Ala Leu Glu Ser Lys Ile
 290 295 300
 Asn Gly Lys Asn Ile Ala Glu Leu Cys Ala Met Glu Val Arg Asp Leu
 305 310 315 320
 Ala Lys Trp Ile Lys Thr Val Glu Ala Pro Ser Val Ala Pro Leu Leu
 325 330 335
 Thr Ala Leu Thr Glu Thr Leu Asp Asn Phe Val Glu Ile Gly Leu Gly
 340 345 350
 Tyr Ile Gln Leu Asp Arg Pro Ala Gly Thr Leu Ser Gly Gly Glu Ala
 355 360 365
 Gln Arg Thr Lys Met Ile Arg His Leu Gly Ser Ala Leu Thr Asp Val
 370 375 380
 Thr Tyr Val Phe Asp Glu Pro Thr Ala Gly Leu His Ala Tyr Asp Ile
 385 390 395 400
 Glu Arg Met Asn Lys Leu Leu Leu Asp Leu Arg Asp Lys Gly Asn Thr
 405 410 415
 Val Leu Val Val Glu His Lys Pro Glu Thr Ile Ala Ile Ala Asp His
 420 425 430
 Val Val Asp Leu Gly Pro Gly Ala Gly Ala Gly Gly Glu Ile Arg
 435 440 445
 Phe Glu Gly Ser Val Asp Lys Leu Lys Asp Ser Asp Thr Val Thr Gly
 450 455 460
 Leu His Phe Asn Asp Arg Ala Ser Leu Lys Glu Ser Val Arg Ala Pro
 465 470 475 480
 His Gly Ala Leu Glu Ile Arg Gly Ala Asp Arg Asn Asn Leu Asn Asn
 485 490 495

Val Asp Val Asp Ile Pro Leu Gly Val Phe Thr Ala Ile Ser Gly Val
 500 505 510

Ala Gly Ser Gly Lys Ser Ser Leu Ile
 515 520

<210> 151

<211> 864

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(841)

<223> RXA00995

<400> 151

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acgaagatgc tttcttggct gccattgacg gggtaaggct atg aac cct cac tat 115
                                   Met Asn Pro His Tyr
                                   1                               5

ctg ctt gcc acg gtc aaa cga gtc ctg ctg cag ctg aaa gcc gat aaa 163
Leu Leu Ala Thr Val Lys Arg Val Leu Leu Gln Leu Lys Ala Asp Lys
                                   10                               15                               20

cgt tcc atc gcg ctg att ctt cta gca ccc gtg gcg ttg atg tcg ctg 211
Arg Ser Ile Ala Leu Ile Leu Leu Ala Pro Val Ala Leu Met Ser Leu
                                   25                               30                               35

ttt tat tac atg tat tcc tcc aca ccg gca ggc acc cag ctg ttt aag 259
Phe Tyr Tyr Met Tyr Ser Ser Thr Pro Ala Gly Thr Gln Leu Phe Lys
                                   40                               45                               50

acc att tcc acg gtc atg atc gca gtg ttc ccc ttg atg ctc atg ttt 307
Thr Ile Ser Thr Val Met Ile Ala Val Phe Pro Leu Met Leu Met Phe
                                   55                               60                               65

ttg atg acg tcg gtg acg atg caa aga gaa cgc aac gct gga acg ctc 355
Leu Met Thr Ser Val Thr Met Gln Arg Glu Arg Asn Ala Gly Thr Leu
                                   70                               75                               80                               85

gag cgc ttg tgg acc acg aac att cac cgc gtt gat ttg atc ggt ggc 403
Glu Arg Leu Trp Thr Thr Asn Ile His Arg Val Asp Leu Ile Gly Gly
                                   90                               95                               100

tac ggg gtg gcc ttc ggc atc atg gcg gtg gcg caa tct ttg ctc atg 451
Tyr Gly Val Ala Phe Gly Ile Met Ala Val Ala Gln Ser Leu Leu Met
                                   105                               110                               115

gtg ctc acc ctt cgg tat ctc ctg ggt gtg gaa acc gaa tcg gag tgg 499
Val Leu Thr Leu Arg Tyr Leu Leu Gly Val Glu Thr Glu Ser Glu Trp
                                   120                               125                               130

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tgg att tct acg ctc att gct gcg atc acc ggt ctt atc gga gtg tct 547
 Trp Ile Ser Thr Leu Ile Ala Ala Ile Thr Gly Leu Ile Gly Val Ser
 135 140 145

ctt ggc ctg ttg agc tct gcg ttt gcc agc act gag ttc caa gct atc 595
 Leu Gly Leu Leu Ser Ser Ala Phe Ala Ser Thr Glu Phe Gln Ala Ile
 150 155 160 165

caa acg ctg ccg ttg ctt att ttg ccc cag ttc cta ttg tgc ggt ttg 643
 Gln Thr Leu Pro Leu Leu Ile Leu Pro Gln Phe Leu Leu Cys Gly Leu
 170 175-- 180

ctg atc cca cgg gat gat ctg ccg gat gtg ttg cgc tgg gtt tct aat 691
 Leu Ile Pro Arg Asp Asp Leu Pro Asp Val Leu Arg Trp Val Ser Asn
 185 190 195

gtg ttg ccg ctg tcc tat gca gtt gat gca gcg ctt gag gcc tca cgg 739
 Val Leu Pro Leu Ser Tyr Ala Val Asp Ala Ala Leu Glu Ala Ser Arg
 200 205 210

acg gga atc gga cag caa gta gtg gtc aac att gcc atc tgc gcc gcg 787
 Thr Gly Ile Gly Gln Gln Val Val Val Asn Ile Ala Ile Cys Ala Ala
 215 220 225

ttt gcc gtg agc ttc ctg ctg gtg gcg gcg cta tcg atg ccg aga atg 835
 Phe Ala Val Ser Phe Leu Leu Val Ala Ala Leu Ser Met Pro Arg Met
 230 235 240 245

acc cgc tagattactc ttccagcgag gtg 864
 Thr Arg

<210> 152

<211> 247

<212> PRT

<213> Corynebacterium glutamicum

<400> 152

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Leu Lys Ala Asp Lys Arg Ser Ile Ala Leu Ile Leu Leu Ala Pro Val
20 25 30

Ala Leu Met Ser Leu Phe Tyr Tyr Met Tyr Ser Ser Thr Pro Ala Gly
35 40 45

Thr Gln Leu Phe Lys Thr Ile Ser Thr Val Met Ile Ala Val Phe Pro
50 55 60

Leu Met Leu Met Phe Leu Met Thr Ser Val Thr Met Gln Arg Glu Arg
65 70 75 80

Asn Ala Gly Thr Leu Glu Arg Leu Trp Thr Thr Asn Ile His Arg Val
85 90 95

Asp Leu Ile Gly Gly Tyr Gly Val Ala Phe Gly Ile Met Ala Val Ala
 100 105 110
 Gln Ser Leu Leu Met Val Leu Thr Leu Arg Tyr Leu Leu Gly Val Glu
 115 120 125
 Thr Glu Ser Glu Trp Trp Ile Ser Thr Leu Ile Ala Ala Ile Thr Gly
 130 135 140
 Leu Ile Gly Val Ser Leu Gly Leu Leu Ser Ser Ala Phe Ala Ser Thr
 145 150 155 160
 Glu Phe Gln Ala Ile Gln Thr Leu Pro Leu Leu Ile Leu Pro Gln Phe
 165 170 175
 Leu Leu Cys Gly Leu Leu Ile Pro Arg Asp Asp Leu Pro Asp Val Leu
 180 185 190
 Arg Trp Val Ser Asn Val Leu Pro Leu Ser Tyr Ala Val Asp Ala Ala
 195 200 205
 Leu Glu Ala Ser Arg Thr Gly Ile Gly Gln Gln Val Val Val Asn Ile
 210 215 220
 Ala Ile Cys Ala Ala Phe Ala Val Ser Phe Leu Leu Val Ala Ala Leu
 225 230 235 240
 Ser Met Pro Arg Met Thr Arg
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<210> 153
 <211> 1353
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(1330)
 <223> RXN00803

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 Met Gly Val Ser Ala
 1 5
 ctt aac atg tct gac atg gtg gcg aac aaa cgg gca cag cgt aaa gtc 163
 Leu Asn Met Ser Asp Met Val Ala Asn Lys Arg Ala Gln Arg Lys Val
 10 15 20
 tgg cta gcg gta gct tta tcg gtc ttt acg gtc gcg tgg ggt ggc aat 211
 Trp Leu Ala Val Ala Leu Ser Val Phe Thr Val Ala Trp Gly Gly Asn
 25 30 35
 gaa ttc act ccc ttg ctg gtg ttt tac cga ggt gaa ggg ttc ttt agc 259

| | |
|---|-----|
| Glu Phe Thr Pro Leu Leu Val Phe Tyr Arg Gly Glu Gly Phe Phe Ser | |
| 40 45 50 | |
| aac ctg ttc atc gac ctt ttg ctg gtg ttt tat gcc atc gga gta gcg | 307 |
| Asn Leu Phe Ile Asp Leu Leu Leu Val Phe Tyr Ala Ile Gly Val Ala | |
| 55 60 65 | |
| gta ggt ttg ctg gca gct ggt cct tta tct gac cgc tat ggc cga cgt | 355 |
| Val Gly Leu Leu Ala Ala Gly Pro Leu Ser Asp Arg Tyr Gly Arg Arg | |
| 70 75 80 85 | |
| gcc gtc atg ttg cct gcg cca ttg atc gcg atc ttg ggt tcc gcg ttg | 403 |
| Ala Val Met Leu Pro Ala Pro Leu Ile Ala Ile Leu Gly Ser Ala Leu | |
| 90 95 100 | |
| att gcc tcg ggt gaa gaa acc gcc atc ctg att gcc att ggt cga gtg | 451 |
| Ile Ala Ser Gly Glu Glu Thr Ala Ile Leu Ile Ala Ile Gly Arg Val | |
| 105 110 115 | |
| ctg tcg gga att tcg gtg ggc atg gtg atg aca gcg gga ggt tcc tgg | 499 |
| Leu Ser Gly Ile Ser Val Gly Met Val Met Thr Ala Gly Gly Ser Trp | |
| 120 125 130 | |
| att aag gag ctt tca tcg tcg cgg ttt gag cca ggg gtg aaa acc agt | 547 |
| Ile Lys Glu Leu Ser Ser Ser Arg Phe Glu Pro Gly Val Lys Thr Ser | |
| 135 140 145 | |
| gct ggt gca aaa cgc gca tcg atg tct ttg acc ggt ggt ttt gcg ctc | 595 |
| Ala Gly Ala Lys Arg Ala Ser Met Ser Leu Thr Gly Gly Phe Ala Leu | |
| 150 155 160 165 | |
| ggc cca gcg ctt gct ggt gtg atg gca cag tgg ctg cca cta cct gga | 643 |
| Gly Pro Ala Leu Ala Gly Val Met Ala Gln Trp Leu Pro Leu Pro Gly | |
| 170 175 180 | |
| cag ttg gca tat gtt ttg cac att att ctc act ctg att ttg ttc ccg | 691 |
| Gln Leu Ala Tyr Val Leu His Ile Ile Leu Thr Leu Ile Leu Phe Pro | |
| 185 190 195 | |
| ttg ctt att aca gcg ccg gaa act cgt caa tca gcg cac ctg aaa act | 739 |
| Leu Leu Ile Thr Ala Pro Glu Thr Arg Gln Ser Ala His Leu Lys Thr | |
| 200 205 210 | |
| aag gga tca ttc tgg tca gat gtg ctt gtg cca tct gca cta gac aag | 787 |
| Lys Gly Ser Phe Trp Ser Asp Val Leu Val Pro Ser Ala Leu Asp Lys | |
| 215 220 225 | |
| cga ttc ttg ttt gtg gtt gct cca att gga ccg tgg gtt ttc ggt gcg | 835 |
| Arg Phe Leu Phe Val Val Ala Pro Ile Gly Pro Trp Val Phe Gly Ala | |
| 230 235 240 245 | |
| gcc ttc act gcc tac gca gtt ttg ccg tcg cag ctg cgt gac atg gtt | 883 |
| Ala Phe Thr Ala Tyr Ala Val Leu Pro Ser Gln Leu Arg Asp Met Val | |
| 250 255 260 | |
| tct gca ccc gtt gcg tat tct gcg ctg atc gct ttg gtt acc tta ggt | 931 |
| Ser Ala Pro Val Ala Tyr Ser Ala Leu Ile Ala Leu Val Thr Leu Gly | |

| 265 | 270 | 275 | |
|---|-----|-----|------|
| tct gga ttt ggt atc caa caa ttc ggt cct caa atc atg ggc acc tct | | | 979 |
| Ser Gly Phe Gly Ile Gln Gln Phe Gly Pro Gln Ile Met Gly Thr Ser | | | |
| 280 | 285 | 290 | |
| aaa act cgc ggg ccg att ttg gcc atg ttc gtc aca gtc atc ggc atg | | | 1027 |
| Lys Thr Arg Gly Pro Ile Leu Ala Met Phe Val Thr Val Ile Gly Met | | | |
| 295 | 300 | 305 | |
| atc ggc gcg gtg atc gtg gtg atg aac cct cat cca tgg tgg gcg cta | | | 1075 |
| Ile Gly Ala Val Ile Val Val Met Asn Pro His Pro Trp Trp Ala Leu | | | |
| 310 | 315 | 320 | 325 |
| gtt ggc tgc atg gcc ctc ggc ctg tct tat ggc ctg tgt atg ttc atg | | | 1123 |
| Val Gly Cys Met Ala Leu Gly Leu Ser Tyr Gly Leu Cys Met Phe Met | | | |
| 330 | 335 | 340 | |
| ggg ttg gcg gaa act caa aac att gct cca cct att gat atg gca ggc | | | 1171 |
| Gly Leu Ala Glu Thr Gln Asn Ile Ala Pro Pro Ile Asp Met Ala Gly | | | |
| 345 | 350 | 355 | |
| ctg acg ggt att ttc tac tgc ctg acg tac gta ggt atg gtc ttt cca | | | 1219 |
| Leu Thr Gly Ile Phe Tyr Cys Leu Thr Tyr Val Gly Met Val Phe Pro | | | |
| 360 | 365 | 370 | |
| gcc ttg atg acc tgg ttg aat caa tgg ctc agt tac ccg ttc atg ctg | | | 1267 |
| Ala Leu Met Thr Trp Leu Asn Gln Trp Leu Ser Tyr Pro Phe Met Leu | | | |
| 375 | 380 | 385 | |
| ggc ttt ggt gcg gtg atg gca act att tgt ctg atc att gtg agt ttt | | | 1315 |
| Gly Phe Gly Ala Val Met Ala Thr Ile Cys Leu Ile Ile Val Ser Phe | | | |
| 390 | 395 | 400 | 405 |
| agt gca cgc cga ttc tgagaaacaa ctaaagtggag cca | | | 1353 |
| Ser Ala Arg Arg Phe | | | |
| 410 | | | |

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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 154
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 35 40 45
 Glu Gly Phe Phe Ser Asn Leu Phe Ile Asp Leu Leu Leu Val Phe Tyr
 50 55 60

Ala Ile Gly Val Ala Val Gly Leu Leu Ala Ala Gly Pro Leu Ser Asp
 65 70 75 80
 Arg Tyr Gly Arg Arg Ala Val Met Leu Pro Ala Pro Leu Ile Ala Ile
 85 90 95
 Leu Gly Ser Ala Leu Ile Ala Ser Gly Glu Glu Thr Ala Ile Leu Ile
 100 105 110
 Ala Ile Gly Arg Val Leu Ser Gly Ile Ser Val Gly Met Val Met Thr
 115 120 125
 Ala Gly Gly Ser Trp Ile Lys Glu Leu Ser Ser Ser Arg Phe Glu Pro
 130 135 140
 Gly Val Lys Thr Ser Ala Gly Ala Lys Arg Ala Ser Met Ser Leu Thr
 145 150 155 160
 Gly Gly Phe Ala Leu Gly Pro Ala Leu Ala Gly Val Met Ala Gln Trp
 165 170 175
 Leu Pro Leu Pro Gly Gln Leu Ala Tyr Val Leu His Ile Ile Leu Thr
 180 185 190
 Leu Ile Leu Phe Pro Leu Leu Ile Thr Ala Pro Glu Thr Arg Gln Ser
 195 200 205
 Ala His Leu Lys Thr Lys Gly Ser Phe Trp Ser Asp Val Leu Val Pro
 210 215 220
 Ser Ala Leu Asp Lys Arg Phe Leu Phe Val Val Ala Pro Ile Gly Pro
 225 230 235 240
 Trp Val Phe Gly Ala Ala Phe Thr Ala Tyr Ala Val Leu Pro Ser Gln
 245 250 255
 Leu Arg Asp Met Val Ser Ala Pro Val Ala Tyr Ser Ala Leu Ile Ala
 260 265 270
 Leu Val Thr Leu Gly Ser Gly Phe Gly Ile Gln Gln Phe Gly Pro Gln
 275 280 285
 Ile Met Gly Thr Ser Lys Thr Arg Gly Pro Ile Leu Ala Met Phe Val
 290 295 300
 Thr Val Ile Gly Met Ile Gly Ala Val Ile Val Val Met Asn Pro His
 305 310 315 320
 Pro Trp Trp Ala Leu Val Gly Cys Met Ala Leu Gly Leu Ser Tyr Gly
 325 330 335
 Leu Cys Met Phe Met Gly Leu Ala Glu Thr Gln Asn Ile Ala Pro Pro
 340 345 350
 Ile Asp Met Ala Gly Leu Thr Gly Ile Phe Tyr Cys Leu Thr Tyr Val
 355 360 365

Gly Met Val Phe Pro Ala Leu Met Thr Trp Leu Asn Gln Trp Leu Ser
 370 375 380

Tyr Pro Phe Met Leu Gly Phe Gly Ala Val Met Ala Thr Ile Cys Leu
 385 390 395 400

Ile Ile Val Ser Phe Ser Ala Arg Arg Phe
 405 410

<210> 155

<211> 703

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(703)

<223> FRXA00803

<400> 155

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 Met Gly Val Ser Ala
 1 5

ctt aac atg tct gac atg gtg gcg aac aaa cgg gca cag cgt aaa gtc 163
 Leu Asn Met Ser Asp Met Val Ala Asn Lys Arg Ala Gln Arg Lys Val
 10 15 20

tgg cta gcg gta gct tta tcg gtc ttt acg gtc gcg tgg ggt ggc aat 211
 Trp Leu Ala Val Ala Leu Ser Val Phe Thr Val Ala Trp Gly Gly Asn
 25 30 35

gaa ttc act ccc ttg ctg gtg ttt tac cga ggt gaa ggg ttc ttt agc 259
 Glu Phe Thr Pro Leu Leu Val Phe Tyr Arg Gly Glu Gly Phe Phe Ser
 40 45 50

aac ctg ttc atc gac ctt ttg ctg gtg ttt tat gcc atc gga gta gcg 307
 Asn Leu Phe Ile Asp Leu Leu Leu Val Phe Tyr Ala Ile Gly Val Ala
 55 60 65

gta ggt ttg ctg gca gct ggt cct tta tct gac cgc tat ggc cga cgt 355
 Val Gly Leu Leu Ala Ala Gly Pro Leu Ser Asp Arg Tyr Gly Arg Arg
 70 75 80 85

gcc gtc atg ttg cct gcg cca ttg atc gcg atc ttg ggt tcc gcg ttg 403
 Ala Val Met Leu Pro Ala Pro Leu Ile Ala Ile Leu Gly Ser Ala Leu
 90 95 100

att gcc tcg ggt gaa gaa acc gcc atc ctg att gcc att ggt cga gtg 451
 Ile Ala Ser Gly Glu Glu Thr Ala Ile Leu Ile Ala Ile Gly Arg Val
 105 110 115

ctg tcg gga att tcg gtg ggc atg gtg atg aca gcg gga ggt tcc tgg 499
 Leu Ser Gly Ile Ser Val Gly Met Val Met Thr Ala Gly Gly Ser Trp

| 120 | 125 | 130 | |
|---|-----|-----|-----|
| att aag gag ctt tca tcg tcg cgg ttt gag cca ggg gtg aaa acc agt | | | 547 |
| Ile Lys Glu Leu Ser Ser Ser Arg Phe Glu Pro Gly Val Lys Thr Ser | | | |
| 135 | 140 | 145 | |
| gct ggt gca aaa cgc gca tcg atg tct ttg acc ggt ggt ttt gcg ctc | | | 595 |
| Ala Gly Ala Lys Arg Ala Ser Met Ser Leu Thr Gly Gly Phe Ala Leu | | | |
| 150 | 155 | 160 | 165 |
| ggc cca gcg ctt gct ggt gtg atg gca cag tgg ctg cca caa cct gga | | | 643 |
| Gly Pro Ala Leu Ala Gly Val Met Ala Gln Trp Leu Pro Gln Pro Gly | | | |
| 170 | 175 | 180 | |
| cag ttg gca tat gtt ttg cac att att ctc act ctg att ttg ttc ccg | | | 691 |
| Gln Leu Ala Tyr Val Leu His Ile Ile Leu Thr Leu Ile Leu Phe Pro | | | |
| 185 | 190 | 195 | |
| ttg ctt att aca | | | 703 |
| Leu Leu Ile Thr | | | |
| 200 | | | |

<210> 156

<211> 201

<212> PRT

<213> Corynebacterium glutamicum

<400> 156

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|---|
| Met Gly Val Ser Ala Leu Asn Met Ser Asp Met Val Ala Asn Lys Arg |
| 1 5 10 15 |

| |
|---|
| Ala Gln Arg Lys Val Trp Leu Ala Val Ala Leu Ser Val Phe Thr Val |
| 20 25 30 |

| |
|---|
| Ala Trp Gly Gly Asn Glu Phe Thr Pro Leu Leu Val Phe Tyr Arg Gly |
| 35 40 45 |

| |
|---|
| Glu Gly Phe Phe Ser Asn Leu Phe Ile Asp Leu Leu Leu Val Phe Tyr |
| 50 55 60 |

| |
|---|
| Ala Ile Gly Val Ala Val Gly Leu Leu Ala Ala Gly Pro Leu Ser Asp |
| 65 70 75 80 |

| |
|---|
| Arg Tyr Gly Arg Arg Ala Val Met Leu Pro Ala Pro Leu Ile Ala Ile |
| 85 90 95 |

| |
|---|
| Leu Gly Ser Ala Leu Ile Ala Ser Gly Glu Glu Thr Ala Ile Leu Ile |
| 100 105 110 |

| |
|---|
| Ala Ile Gly Arg Val Leu Ser Gly Ile Ser Val Gly Met Val Met Thr |
| 115 120 125 |

| |
|---|
| Ala Gly Gly Ser Trp Ile Lys Glu Leu Ser Ser Ser Arg Phe Glu Pro |
| 130 135 140 |

Gly Val Lys Thr Ser Ala Gly Ala Lys Arg Ala Ser Met Ser Leu Thr

| | | | | | | | | | | | | | | | | | | |
|-----------|-----|-----|------|-----|------|------|-----|-----|-----|-----|-----|------|-----|------|------|------------|-----|-----|
| <400> 157 | | | | | | | | | | | | | | | | | | |
| atccg | ggg | gaa | cgg | atc | ccaa | agat | ctc | ctt | gat | gcc | atc | g | cg | tttt | taac | ctggccagct | 60 | |
| | | | | | | | | | | | | | | | | | | |
| ctgg | ttg | ccc | cagt | gat | cgc | ccc | act | tct | g | gag | gt | cttc | ttg | caa | gat | acc | att | 115 |
| | | | | | | | | | | | | | Leu | Gln | Asp | Thr | Ile | |
| | | | | | | | | | | | | | 1 | | | | 5 | |
| ggt | tgc | cga | tgg | atc | ttc | ctc | ctc | aac | gtg | ccc | tta | gga | atc | atc | gcg | | 163 | |
| Gly | Cys | Arg | Trp | Ile | Phe | Leu | Leu | Asn | Val | Pro | Leu | Gly | Ile | Ile | Ala | | | |
| | | | | 10 | | | | 15 | | | | 20 | | | | | | |
| atc | atg | gct | gga | cta | ttc | atc | cag | ccc | aag | aac | acg | gcc | gtg | aat | gtg | | 211 | |
| Ile | Met | Ala | Gly | Leu | Phe | Ile | Gln | Pro | Lys | Asn | Thr | Ala | Val | Asn | Val | | | |
| | | | 25 | | | 30 | | | 35 | | | | | | | | | |
| aag | cga | ttt | gat | cgg | cca | ggt | ttc | ctc | ggc | gca | atg | ctg | gtg | atg | gtg | | 259 | |
| Lys | Arg | Phe | Asp | Arg | Pro | Gly | Phe | Leu | Gly | Ala | Met | Leu | Val | Met | Val | | | |
| | | 40 | | | | 45 | | | | | | 50 | | | | | | |
| gcg | caa | gcc | gtg | att | gcg | gag | tta | att | tgc | agc | aga | agt | ccg | gcc | gca | | 307 | |
| Ala | Gln | Ala | Val | Ile | Ala | Glu | Leu | Ile | Cys | Ser | Arg | Ser | Pro | Ala | Ala | | | |
| 55 | | | | | | 60 | | | | | | 65 | | | | | | |
| ctt | act | atc | tgt | gca | tgc | ctc | gtc | tta | agt | gct | gcg | gtg | gta | tgc | ggt | | 355 | |
| Leu | Thr | Ile | Cys | Ala | Cys | Leu | Val | Leu | Ser | Ala | Ala | Val | Val | Cys | Gly | | | |
| 70 | | | | | | 75 | | | | 80 | | | | 85 | | | | |
| ttt | gta | gtg | cgc | tgg | ctg | cga | gtt | cca | ggc | cga | ctt | ttt | gat | ctc | agc | | 403 | |
| Phe | Val | Val | Arg | Trp | Leu | Arg | Val | Pro | Gly | Arg | Leu | Phe | Asp | Leu | Ser | | | |
| | | | | 90 | | | | 95 | | | | 100 | | | | | | |
| atc | atg | cgc | atc | cca | ggt | ttc | cga | gtg | ggt | aat | tcc | tcc | gga | agt | atc | | 451 | |
| Ile | Met | Arg | Ile | Pro | Gly | Phe | Arg | Val | Gly | Asn | Ser | Ser | Gly | Ser | Ile | | | |
| | | | 105 | | | 110 | | | 115 | | | | | | | | | |

tac cgc ttg gta atc acc gca gca cca ttc atg ttc act ttg ctc ttc 499
 Tyr Arg Leu Val Ile Thr Ala Ala Pro Phe Met Phe Thr Leu Leu Phe
 120 125 130

caa gtg gcg ttt ggg tgg tct gca aca tta gcg ggt gcc atg gtg gtc 547
 Gln Val Ala Phe Gly Trp Ser Ala Thr Leu Ala Gly Ala Met Val Val
 135 140 145

gca cta ttc gca ggc aac gtg gca atc aaa cct ttc acc acg ccg atc 595
 Ala Leu Phe Ala Gly Asn Val Ala Ile Lys Pro Phe Thr Thr Pro Ile
 150 155 160 165

att aaa cgc tgg aat ttc aaa cca gta ctg gtc ttt tct aac gct gct 643
 Ile Lys Arg Trp Asn Phe Lys Pro Val Leu Val Phe Ser Asn Ala Ala
 170 175 180

ggc gcc ttg gta ttg gca act ttt ttg ttc gtt cgt gca gat acc cca 691
 Gly Ala Leu Val Leu Ala Thr Phe Leu Phe Val Arg Ala Asp Thr Pro
 185 190 195

ctg gtt ctc atc gtg ctg ctg ctc ttt gtt tcg ggc gca tta agg tcc 739
 Leu Val Leu Ile Val Leu Leu Leu Phe Val Ser Gly Ala Leu Arg Ser
 200 205 210

ctc ggt ttc agc gcc tac aac acc ttg cag ttt gtc gat atc tca cca 787
 Leu Gly Phe Ser Ala Tyr Asn Thr Leu Gln Phe Val Asp Ile Ser Pro
 215 220 225

gaa caa acc agc aac gcc aac gtg tta tca gca acc ctg cac caa cta 835
 Glu Gln Thr Ser Asn Ala Asn Val Leu Ser Ala Thr Leu His Gln Leu
 230 235 240 245

ggc atg tct ttg ggt att gcg gta gca gtc atc gcc atg tcc ctt gca 883
 Gly Met Ser Leu Gly Ile Ala Val Ala Val Ile Ala Met Ser Leu Ala
 250 255 260

ccc acc gcc aac tgg gca ttc cca ctg gca gca gcg ttg ttc ctc att 931
 Pro Thr Ala Asn Trp Ala Phe Pro Leu Ala Ala Ala Leu Phe Leu Ile
 265 270 275

cct cta atc ggc gca cta tct ttg cct cgc gac ggc ggt gcc cga gcc 979
 Pro Leu Ile Gly Ala Leu Ser Leu Pro Arg Asp Gly Gly Ala Arg Ala
 280 285 290

ttt tcc tcc tct tagaaaccca cttctgaaag gta 1014
 Phe Ser Ser Ser
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<210> 158

<211> 297

<212> PRT

<213> Corynebacterium glutamicum

<400> 158

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 20 25 30
 Thr Ala Val Asn Val Lys Arg Phe Asp Arg Pro Gly Phe Leu Gly Ala
 35 40 45
 Met Leu Val Met Val Ala Gln Ala Val Ile Ala Glu Leu Ile Cys Ser
 50 55 60
 Arg Ser Pro Ala Ala Leu Thr Ile Cys Ala Cys Leu Val Leu Ser Ala
 65 70 75 80
 Ala Val Val Cys Gly Phe Val Val Arg Trp Leu Arg Val Pro Gly Arg
 85 90 95
 Leu Phe Asp Leu Ser Ile Met Arg Ile Pro Gly Phe Arg Val Gly Asn
 100 105 110
 Ser Ser Gly Ser Ile Tyr Arg Leu Val Ile Thr Ala Ala Pro Phe Met
 115 120 125
 Phe Thr Leu Leu Phe Gln Val Ala Phe Gly Trp Ser Ala Thr Leu Ala
 130 135 140
 Gly Ala Met Val Val Ala Leu Phe Ala Gly Asn Val Ala Ile Lys Pro
 145 150 155 160
 Phe Thr Thr Pro Ile Ile Lys Arg Trp Asn Phe Lys Pro Val Leu Val
 165 170 175
 Phe Ser Asn Ala Ala Gly Ala Leu Val Leu Ala Thr Phe Leu Phe Val
 180 185 190
 Arg Ala Asp Thr Pro Leu Val Leu Ile Val Leu Leu Leu Phe Val Ser
 195 200 205
 Gly Ala Leu Arg Ser Leu Gly Phe Ser Ala Tyr Asn Thr Leu Gln Phe
 210 215 220
 Val Asp Ile Ser Pro Glu Gln Thr Ser Asn Ala Asn Val Leu Ser Ala
 225 230 235 240
 Thr Leu His Gln Leu Gly Met Ser Leu Gly Ile Ala Val Ala Val Ile
 245 250 255
 Ala Met Ser Leu Ala Pro Thr Ala Asn Trp Ala Phe Pro Leu Ala Ala
 260 265 270
 Ala Leu Phe Leu Ile Pro Leu Ile Gly Ala Leu Ser Leu Pro Arg Asp
 275 280 285
 Gly Gly Ala Arg Ala Phe Ser Ser Ser
 290 295

<210> 159

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<400> 160
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Gly Ala Leu Phe Leu Glu Ile Leu Asp Gly Thr Ile Leu Thr Thr Ala
      20                               25                          30

Val Pro Ala Ile Ala Arg Asp Phe Gly Ile Asp Ala Val Asp Val Ser
      35                               40                          45

Ile Ala Leu Val Ala Tyr Leu Ala Ala Ala Ala Ala Gly Ile Pro Leu
      50                               55                          60

Gln Gly Gly
  65

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<210> 161
<211> 1275
<212> DNA
<213> Corynebacterium glutamicum
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<221> CDS
<222> (101)..(1252)
<223> RXN01922
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<400> 161

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cccaagaaaa catgctgctt atgaattaaa gtgagcaccc atg aga tca gga aac 115
Met Arg Ser Gly Asn
1 5

gcc aat cgc gtc ttc ata ggt gtt acc atc ctg ctg ttt act gca gga 163
Ala Asn Arg Val Phe Ile Gly Val Thr Ile Leu Leu Phe Thr Ala Gly
10 15 20

tgg gca gcc aat cat ttc gcg tca gtg ttg gtg ttg atc cgt gaa caa 211
Trp Ala Ala Asn His Phe Ala Ser Val Leu Val Leu Ile Arg Glu Gln
25 30 35

tta gac gta tca agc gtg ctg gtc aac ggc gct ttt ggt att tat gca 259
Leu Asp Val Ser Ser Val Leu Val Asn Gly Ala Phe Gly Ile Tyr Ala
40 45 50

ctg gga ctt ctt cca agt ttg ctc gca ggc ggt gtg ctt gcc gac cgt 307
Leu Gly Leu Leu Pro Ser Leu Leu Ala Gly Gly Val Leu Ala Asp Arg
55 60 65

ttt ggt gcc cgc atg gtg gta ctc acc gga ggt gta ctt tct gcg ctt 355
Phe Gly Ala Arg Met Val Val Leu Thr Gly Gly Val Leu Ser Ala Leu
70 75 80 85

gga aac ctt tct ctt tta gcg ttt cat gat ggt cct tcc ctc ctg gta 403
Gly Asn Leu Ser Leu Leu Ala Phe His Asp Gly Pro Ser Leu Leu Val
90 95 100

gga cga ttc atc gtt ggt ctg ggc gtt gga tta gtc gtc agc gcg ggc 451
Gly Arg Phe Ile Val Gly Leu Gly Val Gly Leu Val Val Ser Ala Gly
105 110 115

acc gca tgg gcg ggc aga ttg cgc gga gca agc ggc gtg aca ttg gcc 499
Thr Ala Trp Ala Gly Arg Leu Arg Gly Ala Ser Gly Val Thr Leu Ala
120 125 130

ggc att att ctg acc gcc ggt ttc atg atg ggg ccg att gtg aca agt 547
Gly Ile Ile Leu Thr Ala Gly Phe Met Met Gly Pro Ile Val Thr Ser
135 140 145

ggg ttg ggg atg gcg tcg aca agc att att acg ccc ttt gcc ata agc 595
 Gly Leu Gly Met Ala Ser Thr Ser Ile Ile Thr Pro Phe Ala Ile Ser
 150 155 160 165

gtt gcc ctc tcg ctg atc gcg gtg gtt gtg gga ttt gcg ctt ggc gat 643
 Val Ala Leu Ser Leu Ile Ala Val Val Val Gly Phe Ala Leu Gly Asp
 170 175 180

gcc cgc agc acc ccg agc gca ctt ggc gca tcc agc gga atc aaa cac 691
 Ala Arg Ser Thr Pro Ser Ala Leu Gly Ala Ser Ser Gly Ile Lys His
 185 190 195

gaa cga agc atg aaa aag gcc ctc gcg gtg tcc ttg ccg atg gca att 739
 Glu Arg Ser Met Lys Lys Ala Leu Ala Val Ser Leu Pro Met Ala Ile
 200 205 210

tgg gtg ttc agc tgc atc acc acc tcc ctg atc gtg atg tcc gcg cgc 787
 Trp Val Phe Ser Cys Ile Thr Thr Ser Leu Ile Val Met Ser Ala Arg
 215 220 225

atc gac tcc acc ttc ggc aac gcc att ctt ctc ccc gga atc ggc gcg 835
 Ile Asp Ser Thr Phe Gly Asn Ala Ile Leu Leu Pro Gly Ile Gly Ala
 230 235 240 245

gcg atc gcc ttc agc gca ggc ctg atc gca caa ttt tta ggt agg aaa 883
 Ala Ile Ala Phe Ser Ala Gly Leu Ile Ala Gln Phe Leu Gly Arg Lys
 250 255 260

ttc gcg tgg ggt cgt ggc tcc gga atc gtg ggc gcg ctg tgt gcc ctc 931
 Phe Ala Trp Gly Arg Gly Ser Gly Ile Val Gly Ala Leu Cys Ala Leu
 265 270 275

gcg ggt ttt gcg ctg gca gct ttt ggt ggc gac tcc att cca gtg tgg 979
 Ala Gly Phe Ala Leu Ala Ala Phe Gly Gly Asp Ser Ile Pro Val Trp
 280 285 290

ctt ttc gtt atc gcc tcg atc ctg ttc ggc acc gca tat ggc ctc tgc 1027
 Leu Phe Val Ile Ala Ser Ile Leu Phe Gly Thr Ala Tyr Gly Leu Cys
 295 300 305

ctg cgc gaa ggc ctc ctc agc atc gaa act tac acg cca ctc aac cga 1075
 Leu Arg Glu Gly Leu Leu Ser Ile Glu Thr Tyr Thr Pro Leu Asn Arg
 310 315 320 325

cgt ggc acc ggc atc ggc atc tat tat gtg ttc acg tat ttg gga ttc 1123
 Arg Gly Thr Gly Ile Gly Ile Tyr Tyr Val Phe Thr Tyr Leu Gly Phe
 330 335 340

ggg ctg cca gtg ctt ctc gac gcc ctc ctc ccg cac ctt ggc gcc tcc 1171
 Gly Leu Pro Val Leu Leu Asp Ala Leu Leu Pro His Leu Gly Ala Ser
 345 350 355

att ccg ctg tac gcg ctg gcg gcg ctc gcc ctt ggc tcc gca gta atc 1219
 Ile Pro Leu Tyr Ala Leu Ala Ala Leu Ala Leu Gly Ser Ala Val Ile
 360 365 370

cgc ggc gta caa atc aag cgc ggg tat gtg gtt tagatttcta cctacgacct 1272
 Arg Gly Val Gln Ile Lys Arg Gly Tyr Val Val
 375 380

gaa 1275

<210> 162
 <211> 384
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 162

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| Met | Arg | Ser | Gly | Asn | Ala | Asn | Arg | Val | Phe | Ile | Gly | Val | Thr | Ile | Leu |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |
| Leu | Phe | Thr | Ala | Gly | Trp | Ala | Ala | Asn | His | Phe | Ala | Ser | Val | Leu | Val |
| | | | 20 | | | | | 25 | | | | | 30 | | |
| Leu | Ile | Arg | Glu | Gln | Leu | Asp | Val | Ser | Ser | Val | Leu | Val | Asn | Gly | Ala |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Phe | Gly | Ile | Tyr | Ala | Leu | Gly | Leu | Leu | Pro | Ser | Leu | Leu | Ala | Gly | Gly |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Val | Leu | Ala | Asp | Arg | Phe | Gly | Ala | Arg | Met | Val | Val | Leu | Thr | Gly | Gly |
| | 65 | | | | 70 | | | | 75 | | | | | 80 | |
| Val | Leu | Ser | Ala | Leu | Gly | Asn | Leu | Ser | Leu | Leu | Ala | Phe | His | Asp | Gly |
| | | | 85 | | | | | 90 | | | | | | 95 | |
| Pro | Ser | Leu | Leu | Val | Gly | Arg | Phe | Ile | Val | Gly | Leu | Gly | Val | Gly | Leu |
| | | 100 | | | | | 105 | | | | | | 110 | | |
| Val | Val | Ser | Ala | Gly | Thr | Ala | Trp | Ala | Gly | Arg | Leu | Arg | Gly | Ala | Ser |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Gly | Val | Thr | Leu | Ala | Gly | Ile | Ile | Leu | Thr | Ala | Gly | Phe | Met | Met | Gly |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Pro | Ile | Val | Thr | Ser | Gly | Leu | Gly | Met | Ala | Ser | Thr | Ser | Ile | Ile | Thr |
| | 145 | | | | 150 | | | | | 155 | | | | | 160 |
| Pro | Phe | Ala | Ile | Ser | Val | Ala | Leu | Ser | Leu | Ile | Ala | Val | Val | Val | Gly |
| | | | 165 | | | | | 170 | | | | | | 175 | |
| Phe | Ala | Leu | Gly | Asp | Ala | Arg | Ser | Thr | Pro | Ser | Ala | Leu | Gly | Ala | Ser |
| | | 180 | | | | | | 185 | | | | | 190 | | |
| Ser | Gly | Ile | Lys | His | Glu | Arg | Ser | Met | Lys | Lys | Ala | Leu | Ala | Val | Ser |
| | 195 | | | | | | 200 | | | | | 205 | | | |
| Leu | Pro | Met | Ala | Ile | Trp | Val | Phe | Ser | Cys | Ile | Thr | Thr | Ser | Leu | Ile |
| | 210 | | | | | 215 | | | | | 220 | | | | |
| Val | Met | Ser | Ala | Arg | Ile | Asp | Ser | Thr | Phe | Gly | Asn | Ala | Ile | Leu | Leu |
| | 225 | | | | 230 | | | | | 235 | | | | 240 | |
| Pro | Gly | Ile | Gly | Ala | Ala | Ile | Ala | Phe | Ser | Ala | Gly | Leu | Ile | Ala | Gln |
| | | | 245 | | | | | 250 | | | | | | 255 | |
| Phe | Leu | Gly | Arg | Lys | Phe | Ala | Trp | Gly | Arg | Gly | Ser | Gly | Ile | Val | Gly |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| | | | 260 | | | | | 265 | | | | | 270 | | | |
| Ala | Leu | Cys | Ala | Leu | Ala | Gly | Phe | Ala | Leu | Ala | Ala | Phe | Gly | Gly | Asp | |
| | | 275 | | | | | 280 | | | | | 285 | | | | |
| Ser | Ile | Pro | Val | Trp | Leu | Phe | Val | Ile | Ala | Ser | Ile | Leu | Phe | Gly | Thr | |
| | 290 | | | | | 295 | | | | | 300 | | | | | |
| Ala | Tyr | Gly | Leu | Cys | Leu | Arg | Glu | Gly | Leu | Leu | Ser | Ile | Glu | Thr | Tyr | |
| 305 | | | | | 310 | | | | | | 315 | | | | 320 | |
| Thr | Pro | Leu | Asn | Arg | Arg | Gly | Thr | Gly | Ile | Gly | Ile | Tyr | Tyr | Val | Phe | |
| | | | | 325 | | | | | 330 | | | | | 335 | | |
| Thr | Tyr | Leu | Gly | Phe | Gly | Leu | Pro | Val | Leu | Leu | Asp | Ala | Leu | Leu | Pro | |
| | | | 340 | | | | | 345 | | | | | 350 | | | |
| His | Leu | Gly | Ala | Ser | Ile | Pro | Leu | Tyr | Ala | Leu | Ala | Ala | Leu | Ala | Leu | |
| | | 355 | | | | | 360 | | | | | 365 | | | | |
| Gly | Ser | Ala | Val | Ile | Arg | Gly | Val | Gln | Ile | Lys | Arg | Gly | Tyr | Val | Val | |
| | 370 | | | | | 375 | | | | | | 380 | | | | |

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<210> 163
<211> 1130
<212> DNA
<213> Corynebacterium glutamicum
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<220>  
<221> CDS  
<222> (1)..(1107)  
<223> FRXA01922
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| <400> 163 | | | | | | | | | | | | | | | | |
| ctg | ctg | ttt | act | gca | gga | tgg | gca | gcc | aat | cat | ttc | gcg | tca | gtg | ttg | 48 |
| Leu | Leu | Phe | Thr | Ala | Gly | Trp | Ala | Ala | Asn | His | Phe | Ala | Ser | Val | Leu | |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | | |
| | | | | | | | | | | | | | | | | |
| gtg | ttg | atc | cgt | gaa | caa | tta | gac | gta | tca | agc | gtg | ctg | gtc | aac | ggc | 96 |
| Val | Leu | Ile | Arg | Glu | Gln | Leu | Asp | Val | Ser | Ser | Val | Leu | Val | Asn | Gly | |
| | | | 20 | | | | | 25 | | | | | 30 | | | |
| | | | | | | | | | | | | | | | | |
| gct | ttt | ggc | att | tat | gca | ctg | gga | ctt | ctt | cca | agt | ttg | ctc | gca | ggc | 144 |
| Ala | Phe | Gly | Ile | Tyr | Ala | Leu | Gly | Leu | Leu | Pro | Ser | Leu | Leu | Ala | Gly | |
| | | 35 | | | | | 40 | | | | | 45 | | | | |
| | | | | | | | | | | | | | | | | |
| ggc | gtg | ctt | gcc | gac | cgt | ttt | ggc | gcc | cgc | atg | gtg | gta | ctc | acc | gga | 192 |
| Gly | Val | Leu | Ala | Asp | Arg | Phe | Gly | Ala | Arg | Met | Val | Val | Leu | Thr | Gly | |
| | 50 | | | | | 55 | | | | | 60 | | | | | |
| | | | | | | | | | | | | | | | | |
| ggc | gta | ctt | tct | gca | ctt | gga | aac | ctt | tct | ctt | tta | gca | ttt | cat | gat | 240 |
| Gly | Val | Leu | Ser | Ala | Leu | Gly | Asn | Leu | Ser | Leu | Leu | Ala | Phe | His | Asp | |
| 65 | | | | | 70 | | | | 75 | | | | | | 80 | |

| | |
|---|-----|
| ggt cct tcc ctc ctg gta gga cga ttc atc gtt ggt ctg ggc gtt gga | 288 |
| Gly Pro Ser Leu Leu Val Gly Arg Phe Ile Val Gly Leu Gly Val Gly | |
| 85 90 95 | |
| tta gtc gtc agc gcg ggc acc gca tgg gcg ggc aga ttg cgc gga gca | 336 |
| Leu Val Val Ser Ala Gly Thr Ala Trp Ala Gly Arg Leu Arg Gly Ala | |
| 100 105 110 | |
| agc ggc gtg aca ttg gcc ggc att att ctg acc gcc ggt ttc atg atg | 384 |
| Ser Gly Val Thr Leu Ala Gly Ile Ile Leu Thr Ala Gly Phe Met Met | |
| 115 120 125 | |
| ggg ccg att gtg aca agt ggg ttg ggg atg gcg tcg aca agc att att | 432 |
| Gly Pro Ile Val Thr Ser Gly Leu Gly Met Ala Ser Thr Ser Ile Ile | |
| 130 135 140 | |
| acg ccc ttt gcc ata agc gtt gcc ctc tcg ctg atc gcg gtg gtt gtg | 480 |
| Thr Pro Phe Ala Ile Ser Val Ala Leu Ser Leu Ile Ala Val Val Val | |
| 145 150 155 160 | |
| gga ttt gcg ctt ggc gat gcc cgc agc acc ccg agc gca ctt ggc gca | 528 |
| Gly Phe Ala Leu Gly Asp Ala Arg Ser Thr Pro Ser Ala Leu Gly Ala | |
| 165 170 175 | |
| tcc agc gga atc aaa cac gaa cga agc atg aaa aag gcc ctc gcg gtg | 576 |
| Ser Ser Gly Ile Lys His Glu Arg Ser Met Lys Lys Ala Leu Ala Val | |
| 180 185 190 | |
| tcc ttg ccg atg gca att tgg gtg ttc agc tgc atc acc acc tcc ctg | 624 |
| Ser Leu Pro Met Ala Ile Trp Val Phe Ser Cys Ile Thr Thr Ser Leu | |
| 195 200 205 | |
| atc gtg atg tcc gcg cgc atc gac tcc acc ttc ggc aac gcc att ctt | 672 |
| Ile Val Met Ser Ala Arg Ile Asp Ser Thr Phe Gly Asn Ala Ile Leu | |
| 210 215 220 | |
| ctc ccc gga atc ggc gcg gcg atc gcc ttc agc gca ggc ctg atc gca | 720 |
| Leu Pro Gly Ile Gly Ala Ala Ile Ala Phe Ser Ala Gly Leu Ile Ala | |
| 225 230 235 240 | |
| caa ttt tta ggt agg aaa ttc gcg tgg ggt cgt ggc tcc gga atc gtg | 768 |
| Gln Phe Leu Gly Arg Lys Phe Ala Trp Gly Arg Gly Ser Gly Ile Val | |
| 245 250 255 | |
| ggc gcg ctg tgt gcc ctc gcg ggt ttt gcg ctg gca gct ttt ggt ggc | 816 |
| Gly Ala Leu Cys Ala Leu Ala Gly Phe Ala Leu Ala Ala Phe Gly Gly | |
| 260 265 270 | |
| gac tcc att cca gtg tgg ctt ttc gtt atc gcc tcg atc ctg ttc ggc | 864 |
| Asp Ser Ile Pro Val Trp Leu Phe Val Ile Ala Ser Ile Leu Phe Gly | |
| 275 280 285 | |
| acc gca tat ggc ctc tgc ctg cgc gaa ggc ctc ctc agc atc gaa act | 912 |
| Thr Ala Tyr Gly Leu Cys Leu Arg Glu Gly Leu Leu Ser Ile Glu Thr | |
| 290 295 300 | |

tac acg cca ctc aac cga cgt ggc acc ggc atc ggc atc tat tat gtg 960
 Tyr Thr Pro Leu Asn Arg Arg Gly Thr Gly Ile Gly Ile Tyr Tyr Val
 305 310 315 320
 ttc acg tat ttg gga ttc ggg ctg cca gtg ctt ctc gac gcc ctc ctc 1008
 Phe Thr Tyr Leu Gly Phe Gly Leu Pro Val Leu Leu Asp Ala Leu Leu
 325 330 335
 ccg cac ctt ggc gcc tcc att ccg ctg tac gcg ctg gcg gcg ctc gcc 1056
 Pro His Leu Gly Ala Ser Ile Pro Leu Tyr Ala Leu Ala Ala Leu Ala
 340 345 350
 ctt ggc tcc gca gta atc cgc ggc gta caa atc aag cgc ggg tat gtg 1104
 Leu Gly Ser Ala Val Ile Arg Gly Val Gln Ile Lys Arg Gly Tyr Val
 355 360 365
 gtt tagatttcta cctacgacct gaa 1130
 Val

<210> 164
 <211> 369
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 164
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 Val Leu Ile Arg Glu Gln Leu Asp Val Ser Ser Val Leu Val Asn Gly
 20 25 30
 Ala Phe Gly Ile Tyr Ala Leu Gly Leu Leu Pro Ser Leu Leu Ala Gly
 35 40 45
 Gly Val Leu Ala Asp Arg Phe Gly Ala Arg Met Val Val Leu Thr Gly
 50 55 60
 Gly Val Leu Ser Ala Leu Gly Asn Leu Ser Leu Leu Ala Phe His Asp
 65 70 75 80
 Gly Pro Ser Leu Leu Val Gly Arg Phe Ile Val Gly Leu Gly Val Gly
 85 90 95
 Leu Val Val Ser Ala Gly Thr Ala Trp Ala Gly Arg Leu Arg Gly Ala
 100 105 110
 Ser Gly Val Thr Leu Ala Gly Ile Ile Leu Thr Ala Gly Phe Met Met
 115 120 125
 Gly Pro Ile Val Thr Ser Gly Leu Gly Met Ala Ser Thr Ser Ile Ile
 130 135 140
 Thr Pro Phe Ala Ile Ser Val Ala Leu Ser Leu Ile Ala Val Val Val
 145 150 155 160

Gly Phe Ala Leu Gly Asp Ala Arg Ser Thr Pro Ser Ala Leu Gly Ala
 165 170 175
 Ser Ser Gly Ile Lys His Glu Arg Ser Met Lys Lys Ala Leu Ala Val
 180 185 190
 Ser Leu Pro Met Ala Ile Trp Val Phe Ser Cys Ile Thr Thr Ser Leu
 195 200 205
 Ile Val Met Ser Ala Arg Ile Asp Ser Thr Phe Gly Asn Ala Ile Leu
 210 215 220
 Leu Pro Gly Ile Gly Ala Ala Ile Ala Phe Ser Ala Gly Leu Ile Ala
 225 230 235 240
 Gln Phe Leu Gly Arg Lys Phe Ala Trp Gly Arg Gly Ser Gly Ile Val
 245 250 255
 Gly Ala Leu Cys Ala Leu Ala Gly Phe Ala Leu Ala Ala Phe Gly Gly
 260 265 270
 Asp Ser Ile Pro Val Trp Leu Phe Val Ile Ala Ser Ile Leu Phe Gly
 275 280 285
 Thr Ala Tyr Gly Leu Cys Leu Arg Glu Gly Leu Leu Ser Ile Glu Thr
 290 295 300
 Tyr Thr Pro Leu Asn Arg Arg Gly Thr Gly Ile Gly Ile Tyr Tyr Val
 305 310 315 320
 Phe Thr Tyr Leu Gly Phe Gly Leu Pro Val Leu Leu Asp Ala Leu Leu
 325 330 335
 Pro His Leu Gly Ala Ser Ile Pro Leu Tyr Ala Leu Ala Ala Leu Ala
 340 345 350
 Leu Gly Ser Ala Val Ile Arg Gly Val Gln Ile Lys Arg Gly Tyr Val
 355 360 365

Val

<210> 165
 <211> 362
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (1)..(339)
 <223> RXA02060

<400> 165
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 Glu Phe Ala Arg Ile Leu Lys Pro Lys Gly Gln Val Ile Val Leu Thr
 1 5 10 15

gca gat acc ggc cac ttg gct gag ctt cgt gaa cca ctg ggc atc att 96
 Ala Asp Thr Gly His Leu Ala Glu Leu Arg Glu Pro Leu Gly Ile Ile
 20 25 30

gat gtg gag gcc ggc aaa gtt gat cgc atg atc gaa caa gcg gca ggc 144
 Asp Val Glu Ala Gly Lys Val Asp Arg Met Ile Glu Gln Ala Ala Gly
 35 40 45

cac ctc aag cca gtt ggc gaa aga gac ttg gtg gaa ttt gaa atg ctg 192
 His Leu Lys Pro Val Gly Glu Arg Asp Leu Val Glu Phe Glu Met Leu
 50 55 60

ctg gat caa aaa tcc att gca tct cag atc ggt atg agc cct tct gca 240
 Leu Asp Gln Lys Ser Ile Ala Ser Gln Ile Gly Met Ser Pro Ser Ala
 65 70 75 80

cgc cac att aag cct gag gct ttg gcg gaa cgc atc gcc gct cta cca 288
 Arg His Ile Lys Pro Glu Ala Leu Ala Glu Arg Ile Ala Ala Leu Pro
 85 90 95

gaa caa atg aag gtt aca gcc cgg gcc aag atc acc agg ctg gaa cgc 336
 Glu Gln Met Lys Val Thr Ala Arg Ala Lys Ile Thr Arg Leu Glu Arg
 100 105 110

atc taactcttat ctcaactgggc ctt 362
 Ile

<210> 166
 <211> 113
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 166
 Glu Phe Ala Arg Ile Leu Lys Pro Lys Gly Gln Val Ile Val Leu Thr
 1 5 10 15

Ala Asp Thr Gly His Leu Ala Glu Leu Arg Glu Pro Leu Gly Ile Ile
 20 25 30

Asp Val Glu Ala Gly Lys Val Asp Arg Met Ile Glu Gln Ala Ala Gly
 35 40 45

His Leu Lys Pro Val Gly Glu Arg Asp Leu Val Glu Phe Glu Met Leu
 50 55 60

Leu Asp Gln Lys Ser Ile Ala Ser Gln Ile Gly Met Ser Pro Ser Ala
 65 70 75 80

Arg His Ile Lys Pro Glu Ala Leu Ala Glu Arg Ile Ala Ala Leu Pro
 85 90 95

Glu Gln Met Lys Val Thr Ala Arg Ala Lys Ile Thr Arg Leu Glu Arg
 100 105 110

Ile

<210> 167

<211> 1395

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1372)

<223> RXN01936

<400> 167

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ctaacaata ggcccaacaa agaggtctaa gctctacctg gtg agt ttc cga gat 115
                               Val Ser Phe Arg Asp
                               1                               5

att ttc gct gac acc aga ccg ctg aaa gaa ccg gcc ttc aaa cgc ctc 163
Ile Phe Ala Asp Thr Arg Pro Leu Lys Glu Pro Ala Phe Lys Arg Leu
                               10                               15                               20

tgg ctt ggc aat gtt gcc acc gtc att ggt gcc caa tta act gtt gtt 211
Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala Gln Leu Thr Val Val
                               25                               30                               35

gcc gtt ccg gtg cag att tac caa atg act ggg tcc tcc ggc tat gtg 259
Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly Ser Ser Gly Tyr Val
                               40                               45                               50

ggc ttg acc ggg ctt ttt ggc ctt att cct ttg gtt att ttt ggc ctt 307
Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu Val Ile Phe Gly Leu
                               55                               60                               65

tat ggt gga tcc att gcg gat gct ttt gat aaa cgc atc gtg ctg atc 355
Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys Arg Ile Val Leu Ile
                               70                               75                               80                               85

tgc acc acg atc ggc atg tgt gtc acc act gcc ggt ttt tgg gtg ctg 403
Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala Gly Phe Trp Val Leu
                               90                               95                               100

acc att tta ggc aat gag aat att tgg ctc ctg tta ata aac ttt tct 451
Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu Leu Ile Asn Phe Ser
                               105                               110                               115

tta cag cag gca ttt ttc gcg gtg aat caa ccc acc cga acg gcg atc 499
Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro Thr Arg Thr Ala Ile
                               120                               125                               130

ctt cga agt att ttg ccg att gat caa tta gcg tcg gca aca tca ctg 547
Leu Arg Ser Ile Leu Pro Ile Asp Gln Leu Ala Ser Ala Thr Ser Leu
                               135                               140                               145

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| | |
|---|------|
| aat atg ctg ctc atg cag acc ggc gca atc gtt ggc ccg ctg atc gca | 595 |
| Asn Met Leu Leu Met Gln Thr Gly Ala Ile Val Gly Pro Leu Ile Ala | |
| 150 155 160 165 | |
| ggt gcg ttg att ccg ctg atc ggt ttc ggg tgg ctg tat ttc ctt gat | 643 |
| Gly Ala Leu Ile Pro Leu Ile Gly Phe Gly Trp Leu Tyr Phe Leu Asp | |
| 170 175 180 | |
| gtt gtc tcc atc atc ccc aca ctg tgg gct gta tgg tca ctg cct tcg | 691 |
| Val Val Ser Ile Ile Pro Thr Leu Trp Ala Val Trp Ser Leu Pro Ser | |
| 185 190 195 | |
| atc aag cca tcc ggc aag gtg atg aag gct ggt ttc gcc agt gtg gtg | 739 |
| Ile Lys Pro Ser Gly Lys Val Met Lys Ala Gly Phe Ala Ser Val Val | |
| 200 205 210 | |
| gat ggc ctg aag tat ttg gct ggc caa ccc gtg ttg ttg atg gtg atg | 787 |
| Asp Gly Leu Lys Tyr Leu Ala Gly Gln Pro Val Leu Leu Met Val Met | |
| 215 220 225 | |
| gtg ctg gat ctt atc gcc atg att ttc ggc atg cca cgt gcg ctt tac | 835 |
| Val Leu Asp Leu Ile Ala Met Ile Phe Gly Met Pro Arg Ala Leu Tyr | |
| 230 235 240 245 | |
| ccc gag atc gca gaa gtg aac ttc ggt ggg ggt gac gcc ggt gca acg | 883 |
| Pro Glu Ile Ala Glu Val Asn Phe Gly Gly Gly Asp Ala Gly Ala Thr | |
| 250 255 260 | |
| atg ctg gcg ttc atg tac tca tcc atg gct gtt ggc gca gtt ctt ggc | 931 |
| Met Leu Ala Phe Met Tyr Ser Ser Met Ala Val Gly Ala Val Leu Gly | |
| 265 270 275 | |
| ggc gtg ctg tct ggt tgg gtg gcc cgg att agc cgc cag ggt gtt gca | 979 |
| Gly Val Leu Ser Gly Trp Val Ala Arg Ile Ser Arg Gln Gly Val Ala | |
| 280 285 290 | |
| gtt tat tgg tgc atc atc gcc tgg ggc gca gcc gtt gct ttg ggt ggt | 1027 |
| Val Tyr Trp Cys Ile Ile Ala Trp Gly Ala Ala Val Ala Leu Gly Gly | |
| 295 300 305 | |
| gtg gca att gtt gtc agc ccc ggc gcg gtg act gcg tgg gcg tgg atg | 1075 |
| Val Ala Ile Val Val Ser Pro Gly Ala Val Thr Ala Trp Ala Trp Met | |
| 310 315 320 325 | |
| ttc atc atc atg atg gtc att ggt ggc atg gct gac atg ttc agc tcg | 1123 |
| Phe Ile Ile Met Met Val Ile Gly Gly Met Ala Asp Met Phe Ser Ser | |
| 330 335 340 | |
| gca gtt cga aac gct att ttg cag cag tct gct gcg gaa cat gtg cag | 1171 |
| Ala Val Arg Asn Ala Ile Leu Gln Gln Ser Ala Ala Glu His Val Gln | |
| 345 350 355 | |
| ggc cga atc caa ggt gtg tgg atc atc gtc gtg gtg ggt gga cct cgt | 1219 |
| Gly Arg Ile Gln Gly Val Trp Ile Ile Val Val Val Gly Gly Pro Arg | |
| 360 365 370 | |
| tta gct gac gtc ctt cac ggt tgg gcc gct gag ccc ctc ggc gca ggt | 1267 |

Leu Ala Asp Val Leu His Gly Trp Ala Ala Glu Pro Leu Gly Ala Gly
 375 380 385

tgg acg gta tta tgg ggc gga gta gcg gtg gtt gta ctc act gca att 1315
 Trp Thr Val Leu Trp Gly Gly Val Ala Val Val Val Leu Thr Ala Ile
 390 395 400 405

tgt atg gtg gcg gtg cct aaa ttc tgg aaa tac gag aaa cca aaa att 1363
 Cys Met Val Ala Val Pro Lys Phe Trp Lys Tyr Glu Lys Pro Lys Ile
 410 415 420

acc ggc atc taaatactta tccatgccca ttt 1395
 Thr Gly Ile

<210> 168
 <211> 424
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 168

Val Ser Phe Arg Asp Ile Phe Ala Asp Thr Arg Pro Leu Lys Glu Pro
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Ala Phe Lys Arg Leu Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala
 20 25 30

Gln Leu Thr Val Val Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly
 35 40 45

Ser Ser Gly Tyr Val Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu
 50 55 60

Val Ile Phe Gly Leu Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys
 65 70 75 80

Arg Ile Val Leu Ile Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala
 85 90 95

Gly Phe Trp Val Leu Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu
 100 105 110

Leu Ile Asn Phe Ser Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro
 115 120 125

Thr Arg Thr Ala Ile Leu Arg Ser Ile Leu Pro Ile Asp Gln Leu Ala
 130 135 140

Ser Ala Thr Ser Leu Asn Met Leu Leu Met Gln Thr Gly Ala Ile Val
 145 150 155 160

Gly Pro Leu Ile Ala Gly Ala Leu Ile Pro Leu Ile Gly Phe Gly Trp
 165 170 175

Leu Tyr Phe Leu Asp Val Val Ser Ile Ile Pro Thr Leu Trp Ala Val
 180 185 190

Trp Ser Leu Pro Ser Ile Lys Pro Ser Gly Lys Val Met Lys Ala Gly
 195 200 205
 Phe Ala Ser Val Val Asp Gly Leu Lys Tyr Leu Ala Gly Gln Pro Val
 210 215 220
 Leu Leu Met Val Met Val Leu Asp Leu Ile Ala Met Ile Phe Gly Met
 225 230 235 240
 Pro Arg Ala Leu Tyr Pro Glu Ile Ala Glu Val Asn Phe Gly Gly Gly
 245 250 255
 Asp Ala Gly Ala Thr Met Leu Ala Phe Met Tyr Ser Ser Met Ala Val
 260 265 270
 Gly Ala Val Leu Gly Gly Val Leu Ser Gly Trp Val Ala Arg Ile Ser
 275 280 285
 Arg Gln Gly Val Ala Val Tyr Trp Cys Ile Ile Ala Trp Gly Ala Ala
 290 295 300
 Val Ala Leu Gly Gly Val Ala Ile Val Val Ser Pro Gly Ala Val Thr
 305 310 315 320
 Ala Trp Ala Trp Met Phe Ile Ile Met Met Val Ile Gly Gly Met Ala
 325 330 335
 Asp Met Phe Ser Ser Ala Val Arg Asn Ala Ile Leu Gln Gln Ser Ala
 340 345 350
 Ala Glu His Val Gln Gly Arg Ile Gln Gly Val Trp Ile Ile Val Val
 355 360 365
 Val Gly Gly Pro Arg Leu Ala Asp Val Leu His Gly Trp Ala Ala Glu
 370 375 380
 Pro Leu Gly Ala Gly Trp Thr Val Leu Trp Gly Gly Val Ala Val Val
 385 390 395 400
 Val Leu Thr Ala Ile Cys Met Val Ala Val Pro Lys Phe Trp Lys Tyr
 405 410 415
 Glu Lys Pro Lys Ile Thr Gly Ile
 420

<210> 169
 <211> 945
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(922)
 <223> FRXA01936

| 200 | 205 | 210 | |
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| tgg atc atc gtc gtg gtg ggt gga cct cgt tta gct gac gtc ctt cac | | | 787 |
| Trp Ile Ile Val Val Val Gly Gly Pro Arg Leu Ala Asp Val Leu His | | | |
| 215 | 220 | 225 | |
| ggt tgg gcc gct gag ccc ctc ggc gca ggt tgg acg gta tta tgg ggc | | | 835 |
| Gly Trp Ala Ala Glu Pro Leu Gly Ala Gly Trp Thr Val Leu Trp Gly | | | |
| 230 | 235 | 240 | 245 |
| gga gta gcg gtg gtt gta ctc act gca att tgt atg gtg gcg gtg cct | | | 883 |
| Gly Val Ala Val Val Val Leu Thr Ala Ile Cys Met Val Ala Val Pro | | | |
| 250 | 255 | 260 | |
| aaa ttc tgg aaa tac gag aaa cca aaa att acc ggc atc taaataactta | | | 932 |
| Lys Phe Trp Lys Tyr Glu Lys Pro Lys Ile Thr Gly Ile | | | |
| 265 | 270 | | |
| tccatgccca ttt | | | 945 |

<210> 170
 <211> 274
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 170
 Met Leu Leu Met Gln Thr Gly Ala Ile Val Gly Pro Leu Ile Ala Gly
 1 5 10 15
 Ala Leu Ile Pro Leu Ile Gly Phe Gly Trp Leu Tyr Phe Leu Asp Val
 20 25 30
 Val Ser Ile Ile Pro Thr Leu Trp Ala Val Trp Ser Leu Pro Ser Ile
 35 40 45
 Lys Pro Ser Gly Lys Val Met Lys Ala Gly Phe Ala Ser Val Val Asp
 50 55 60
 Gly Leu Lys Tyr Leu Ala Gly Gln Pro Val Leu Leu Met Val Met Val
 65 70 75 80
 Leu Asp Leu Ile Ala Met Ile Phe Gly Met Pro Arg Ala Leu Tyr Pro
 85 90 95
 Glu Ile Ala Glu Val Asn Phe Gly Gly Gly Asp Ala Gly Ala Thr Met
 100 105 110
 Leu Ala Phe Met Tyr Ser Ser Met Ala Val Gly Ala Val Leu Gly Gly
 115 120 125
 Val Leu Ser Gly Trp Val Ala Arg Ile Ser Arg Gln Gly Val Ala Val
 130 135 140
 Tyr Trp Cys Ile Ile Ala Trp Gly Ala Ala Val Ala Leu Gly Gly Val
 145 150 155 160

Ala Ile Val Val Ser Pro Gly Ala Val Thr Ala Trp Ala Trp Met Phe
 165 170 175

Ile Ile Met Met Val Ile Gly Gly Met Ala Asp Met Phe Ser Ser Ala
 180 185 190

Val Arg Asn Ala Ile Leu Gln Gln Ser Ala Ala Glu His Val Gln Gly
 195 200 205

Arg Ile Gln Gly Val Trp Ile Ile Val Val Val Gly Gly Pro Arg Leu
 210 215 220

Ala Asp Val Leu His Gly Trp Ala Ala Glu Pro Leu Gly Ala Gly Trp
 225 230 235 240

Thr Val Leu Trp Gly Gly Val Ala Val Val Val Leu Thr Ala Ile Cys
 245 250 255

Met Val Ala Val Pro Lys Phe Trp Lys Tyr Glu Lys Pro Lys Ile Thr
 260 265 270

Gly Ile

<210> 171
 <211> 549
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(526)
 <223> FRXA01937

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 Val Ser Phe Arg Asp
 1 5

att ttc gct gac acc aga ccg ctg aaa gaa ccg gcc ttc aaa cgc ctc 163
 Ile Phe Ala Asp Thr Arg Pro Leu Lys Glu Pro Ala Phe Lys Arg Leu
 10 15 20

tgg ctt ggc aat gtt gcc acc gtc att ggt gcc caa tta act gtt gtt 211
 Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala Gln Leu Thr Val Val
 25 30 35

gcc gtt ccg gtg cag att tac caa atg act ggg tcc tcc ggc tat gtg 259
 Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly Ser Ser Gly Tyr Val
 40 45 50

ggc ttg acc ggg ctt ttt ggc ctt att cct ttg gtt att ttt ggc ctt 307
 Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu Val Ile Phe Gly Leu
 55 60 65

tat ggt gga tcc att gcg gat gct ttt gat aaa cgc atc gtg ctg atc 355
 Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys Arg Ile Val Leu Ile
 70 75 80 85

tgc acc acg atc ggc atg tgt gtc acc act gcc ggt ttt tgg gtg ctg 403
 Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala Gly Phe Trp Val Leu
 90 95 100

acc att tta ggc aat gag aat att tgg ctc ctg tta ata aac ttt tct 451
 Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu Leu Ile Asn Phe Ser
 105 110 115

tta cag cag gca ttt ttc gcg gtg aat caa ccc acc cga acg gcg atc 499
 Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro Thr Arg Thr Ala Ile
 120 125 130

ctt cga agt att ttg ccg att gat caa taagcgtcgg caacatcact 546
 Leu Arg Ser Ile Leu Pro Ile Asp Gln
 135 140

gaa 549

<210> 172

<211> 142

<212> PRT

<213> Corynebacterium glutamicum

<400> 172

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Ala Phe Lys Arg Leu Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala
 20 25 30

Gln Leu Thr Val Val Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly
 35 40 45

Ser Ser Gly Tyr Val Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu
 50 55 60

Val Ile Phe Gly Leu Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys
 65 70 75 80

Arg Ile Val Leu Ile Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala
 85 90 95

Gly Phe Trp Val Leu Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu
 100 105 110

Leu Ile Asn Phe Ser Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro
 115 120 125

Thr Arg Thr Ala Ile Leu Arg Ser Ile Leu Pro Ile Asp Gln
 130 135 140

<210> 173
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 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1219)
 <223> RXN01010

<400> 173

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                               Met Lys Lys Leu Gln
                               1                               5

atg ccg gcc att ttg gtc gga ggc ttt gtg ggg ccg ttt act ggc caa 163
Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly Pro Phe Thr Gly Gln
                               10                               15                               20

gct cta tca gtg gtc ttg ccg gaa ttt gca gac acc ttt gat atc agt 211
Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp Thr Phe Asp Ile Ser
                               25                               30                               35

gtc agc cag gca gcg ctg acc atg acc gca tac ttg ttg ccc ttt gcc 259
Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr Leu Leu Pro Phe Ala
                               40                               45                               50

acc atg atg ttg ttt tcg ggg cgc atc acc aga aag atc cat ccg cat 307
Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg Lys Ile His Pro His
                               55                               60                               65

aag gtg gtg cag gcg gct tat att gtc aca ctg cca ctt gcg ctg ttg 355
Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu Pro Leu Ala Leu Leu
                               70                               75                               80                               85

ctc cta gtt aca cca tcg tgg ggg ctg ttt atg gct gcg tat gcc acg 403
Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met Ala Ala Tyr Ala Thr
                               90                               95                               100

att ggt atc gct aat gca ttt acc act ccg gtg ctg caa att atg ttg 451
Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val Leu Gln Ile Met Leu
                               105                               110                               115

cgt gag ctt gtt ccg ccg cgt tct ttg ggt aag gca ttg ggc acc tat 499
Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys Ala Leu Gly Thr Tyr
                               120                               125                               130

gct gcg atg caa tca ctc ggc atg ttg tcg gcg cca ctg atc gca ggt 547
Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala Pro Leu Ile Ala Gly
                               135                               140                               145

gtg tct tcg gtg gtg tcg tgg agg ttg acc ttc ctg gtc act gca gca 595
Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe Leu Val Thr Ala Ala
150                               155                               160                               165

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gcg tca ctg ttt att ttg gtg gcg cga ctc ccc gtt gtt cca cca cca 643
 Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro Val Val Pro Pro Pro
 170 175 180

tca gca tcg aag caa aac gtt agt ggc aag gtg cag tgg gga ccg acc 691
 Ser Ala Ser Lys Gln Asn Val Ser Gly Lys Val Gln Trp Gly Pro Thr
 185 190 195

atc atc cac atg gtt tcc ggc ttt gtg gtg ggc atc ggc atc atc ggc 739
 Ile Ile His Met Val Ser Gly Phe Val Val Gly Ile Gly Ile Ile Gly
 200 205 210

att gga ttc atg aca tcg ctg cac gtt ggc gag caa ttc gga ctt gat 787
 Ile Gly Phe Met Thr Ser Leu His Val Gly Glu Gln Phe Gly Leu Asp
 215 220 225

gct gca gcg cgt ggt ttg gtg gtc atg tgt ggt ggc ctg gct gcg ttc 835
 Ala Ala Ala Arg Gly Leu Val Val Met Cys Gly Gly Leu Ala Ala Phe
 230 235 240 245

ttt gcc tcc cgc aag att ggc gat ttg gca gac aaa ttt ggt gtg cgc 883
 Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp Lys Phe Gly Val Arg
 250 255 260

gcg gtg ctc att gtc agt gct gtc atc ggt acc atc gca ctc gca ctg 931
 Ala Val Leu Ile Val Ser Ala Val Ile Gly Thr Ile Ala Leu Ala Leu
 265 270 275

ctg ccg atc gca ccg tgg atc att gtg gtg gcc gta ctg tgg gcc ttc 979
 Leu Pro Ile Ala Pro Trp Ile Ile Val Val Ala Val Leu Trp Ala Phe
 280 285 290

gca gta gca gca gca caa gga atc caa gca acc gtc aac ttg gct gtc 1027
 Ala Val Ala Ala Ala Gln Gly Ile Gln Ala Thr Val Asn Leu Ala Val
 295 300 305

atc gga agc ccc ggt gga tca tcg ctg ctt tct acc gtg cag gct ttc 1075
 Ile Gly Ser Pro Gly Gly Ser Ser Leu Leu Ser Thr Val Gln Ala Phe
 310 315 320 325

cga ttc ttc gga tca gcg gca gca cca gtg aca ttc ctt cct atc tat 1123
 Arg Phe Phe Gly Ser Ala Ala Ala Pro Val Thr Phe Leu Pro Ile Tyr
 330 335 340

atg ggc atc ggc tcg ggg gcg ttt tgg gtc agc gcg gta gcg ctg ttc 1171
 Met Gly Ile Gly Ser Gly Ala Phe Trp Val Ser Ala Val Ala Leu Phe
 345 350 355

ttc gtt gcc atc gcc cag tgg ctc aac ccg cag cgg gtg gag cgg ggc 1219
 Phe Val Ala Ile Ala Gln Trp Leu Asn Pro Gln Arg Val Glu Arg Gly
 360 365 370

tgagggagac gtcgagaagc gtc 1242

<210> 174

<211> 373

<212> PRT

<213> *Corynebacterium glutamicum*

<400> 174

Met Lys Lys Leu Gln Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly
 1 5 10 15

Pro Phe Thr Gly Gln Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp
 20 25 30

Thr Phe Asp Ile Ser Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr
 35 40 45

Leu Leu Pro Phe Ala Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg
 50 55 60

Lys Ile His Pro His Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu
 65 70 75 80

Pro Leu Ala Leu Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met
 85 90 95

Ala Ala Tyr Ala Thr Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val
 100 105 110

Leu Gln Ile Met Leu Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys
 115 120 125

Ala Leu Gly Thr Tyr Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala
 130 135 140

Pro Leu Ile Ala Gly Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe
 145 150 155 160

Leu Val Thr Ala Ala Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro
 165 170 175

Val Val Pro Pro Pro Ser Ala Ser Lys Gln Asn Val Ser Gly Lys Val
 180 185 190

Gln Trp Gly Pro Thr Ile Ile His Met Val Ser Gly Phe Val Val Gly
 195 200 205

Ile Gly Ile Ile Gly Ile Gly Phe Met Thr Ser Leu His Val Gly Glu
 210 215 220

Gln Phe Gly Leu Asp Ala Ala Ala Arg Gly Leu Val Val Met Cys Gly
 225 230 235 240

Gly Leu Ala Ala Phe Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp
 245 250 255

Lys Phe Gly Val Arg Ala Val Leu Ile Val Ser Ala Val Ile Gly Thr
 260 265 270

Ile Ala Leu Ala Leu Leu Pro Ile Ala Pro Trp Ile Ile Val Val Ala

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<400> 175
gtgccaaagc gtttcctgta aaacgcataa ccccgaaatac cccctgtttc cagatccaaa 60
aaaagatctg gcaggggggtt taggcataga ttaggaactt atg aag aaa ctg caa 115
Met Lys Lys Leu Gln
1 5
atg ccg gcc att ttg gtc gga ggc ttt gtg ggg ccg ttt act ggc caa 163
Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly Pro Phe Thr Gly Gln
10 15 20
gct cta tca gtg gtc ttg ccg gaa ttt gca gac acc ttt gat atc agt 211
Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp Thr Phe Asp Ile Ser
25 30 35
gtc agc cag gca gcg ctg acc atg acc gca tac ttg ttg ccc ttt gcc 259
Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr Leu Leu Pro Phe Ala
40 45 50
acc atg atg ttg ttt tcg ggg cgc atc acc aga aag atc cat ccg cat 307
Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg Lys Ile His Pro His
55 60 65
aag gtg gtg cag gcg gct tat att gtc aca ctg cca ctt gcg ctg ttg 355
Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu Pro Leu Ala Leu Leu
70 75 80 85

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ctc cta gtt aca cca tcg tgg ggg ctg ttt atg gct gcg tat gcc acg 403
 Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met Ala Ala Tyr Ala Thr
 90 95 100

att ggt atc gct aat gca ttt acc act ccg gtg ctg caa att atg ttg 451
 Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val Leu Gln Ile Met Leu
 105 110 115

cgt gag ctt gtt ccg ccg cgt tct ttg ggt aag gca ttg ggc acc tat 499
 Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys Ala Leu Gly Thr Tyr
 120 125 130

gct gcg atg caa tca ctc ggc atg ttg tcg gcg cca ctg atc gca ggt 547
 Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala Pro Leu Ile Ala Gly
 135 140 145

gtg tct tcg gtg gtg tcg tgg agg ttg acc ttc ctg gtc act gca gca 595
 Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe Leu Val Thr Ala Ala
 150 155 160 165

gcg tca ctg ttt att ttg gtg gcg cga ctc ccc gtt gtt cca cca cca 643
 Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro Val Val Pro Pro Pro
 170 175 180

tca gca ttg aag caa aac gtt agt ggc aag gtg cag tgg gga ccg acc 691
 Ser Ala Leu Lys Gln Asn Val Ser Gly Lys Val Gln Trp Gly Pro Thr
 185 190 195

atc atc cac atg gtt tcc ggc ttt gtg gtg ggc atc ggc atc atc ggc 739
 Ile Ile His Met Val Ser Gly Phe Val Val Gly Ile Gly Ile Ile Gly
 200 205 210

att gga ttc atg aca tcg ctg cac gtt ggc gag caa ttc gga ctt aat 787
 Ile Gly Phe Met Thr Ser Leu His Val Gly Glu Gln Phe Gly Leu Asn
 215 220 225

act gca gcg cgt ggt ttg gtg gtc atg tgt ggt ggc cgg gct gcg ttc 835
 Thr Ala Ala Arg Gly Leu Val Val Met Cys Gly Gly Arg Ala Ala Phe
 230 235 240 245

ttt gcc tcc cgc aag ata ggc gat ttg gca gac aaa 871
 Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp Lys
 250 255

<210> 176

<211> 257

<212> PRT

<213> Corynebacterium glutamicum

<400> 176

Met Lys Lys Leu Gln Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly
 1 5 10 15

Pro Phe Thr Gly Gln Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp
 20 25 30

Thr Phe Asp Ile Ser Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr
 35 40 45
 Leu Leu Pro Phe Ala Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg
 50 55 60
 Lys Ile His Pro His Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu
 65 70 75 80
 Pro Leu Ala Leu Leu Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met
 85 90 95
 Ala Ala Tyr Ala Thr Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val
 100 105 110
 Leu Gln Ile Met Leu Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys
 115 120 125
 Ala Leu Gly Thr Tyr Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala
 130 135 140
 Pro Leu Ile Ala Gly Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe
 145 150 155 160
 Leu Val Thr Ala Ala Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro
 165 170 175
 Val Val Pro Pro Pro Ser Ala Leu Lys Gln Asn Val Ser Gly Lys Val
 180 185 190
 Gln Trp Gly Pro Thr Ile Ile His Met Val Ser Gly Phe Val Val Gly
 195 200 205
 Ile Gly Ile Ile Gly Ile Gly Phe Met Thr Ser Leu His Val Gly Glu
 210 215 220
 Gln Phe Gly Leu Asn Thr Ala Ala Arg Gly Leu Val Val Met Cys Gly
 225 230 235 240
 Gly Arg Ala Ala Phe Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp
 245 250 255

Lys

<210> 177
 <211> 1266
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1243)
 <223> RXN03142

<400> 177

gcaatttggc caatcaacaa cataggagga ctgcgtggcg gtcaccgcaa gaacggacat 60

aaaaccacac ccatacgcaac caacggcact gttcactcca gtg ttt att ttg ggc 115
Val Phe Ile Leu Gly
1 5

tgg ctc gtc aac ttg acc cag tac ttg agc ttc tac ttc ctg atc aca 163
Trp Leu Val Asn Leu Thr Gln Tyr Leu Ser Phe Tyr Phe Leu Ile Thr
10 15 20

gtc atg gcg ctg tat gcg atg gaa agc ttc gcc gtt tca gag gcc gct 211
Val Met Ala Leu Tyr Ala Met Glu Ser Phe Ala Val Ser Glu Ala Ala
25 30 35

gtc gga ttt gcg gcc agc tcc ttt gtt atc ggc gca acc gtg gct cgt 259
Val Gly Phe Ala Ala Ser Ser Phe Val Ile Gly Ala Thr Val Ala Arg
40 45 50

gtg ttc gcg gga tgg acg tcc gac cgt ttt ggt aaa aaa cag atc ctg 307
Val Phe Ala Gly Trp Thr Ser Asp Arg Phe Gly Lys Lys Gln Ile Leu
55 60 65

ctc atc ttt gtc ggc ttg gaa gcg gta gca tca cta ttc tat att cca 355
Leu Ile Phe Val Gly Leu Glu Ala Val Ala Ser Leu Phe Tyr Ile Pro
70 75 80 85

gct gcc tca cta cca gcg ctg gtt gct gtg cgt ttt gtt cac ggt ttt 403
Ala Ala Ser Leu Pro Ala Leu Val Ala Val Arg Phe Val His Gly Phe
90 95 100

tct tat tct ctt gct tcc acc gct gtg atg gca ctt gtg cag tcc gtg 451
Ser Tyr Ser Leu Ala Ser Thr Ala Val Met Ala Leu Val Gln Ser Val
105 110 115

att cct gca agc cgt agg gca gag ggc acc ggc tac ttc gcg ctc gga 499
Ile Pro Ala Ser Arg Arg Ala Glu Gly Thr Gly Tyr Phe Ala Leu Gly
120 125 130

tcc aca ctg gct aca gct ttc ggc cca gca att gcg ctg ttt gtt atc 547
Ser Thr Leu Ala Thr Ala Phe Gly Pro Ala Ile Ala Leu Phe Val Ile
135 140 145

gat gac ttc aac tac aac acc ctg ttc tgg att acc act gcg acc agt 595
Asp Asp Phe Asn Tyr Asn Thr Leu Phe Trp Ile Thr Thr Ala Thr Ser
150 155 160 165

gtt ttc ggc ctg atc ctc acc gtt ttg atc cgc aag ccg gag ttc att 643
Val Phe Gly Leu Ile Leu Thr Val Leu Ile Arg Lys Pro Glu Phe Ile
170 175 180

aag aat gcg gaa cac ggc aga gta aag cca gtc tgg tct atc aag act 691
Lys Asn Ala Glu His Gly Arg Val Lys Pro Val Trp Ser Ile Lys Thr
185 190 195

gtt gtg cac cca tcg gtc atg ctc att gga ttc ttc atg ctc gct gtc 739
Val Val His Pro Ser Val Met Leu Ile Gly Phe Phe Met Leu Ala Val

| 200 | 205 | 210 | |
|---|-----|-----|------|
| gga ctg gct tac gca ggc gtg atc acc ttc ctc aac ggc ttc gcg caa Gly Leu Ala Tyr Ala Gly Val Ile Thr Phe Leu Asn Gly Phe Ala Gln 215 220 225 | | | 787 |
| gac act ggc ctc acc gcc gga gcg ggt ctt ttc ttt atc gct tat gcg Asp Thr Gly Leu Thr Ala Gly Ala Gly Leu Phe Phe Ile Ala Tyr Ala 230 235 240 245 | | | 835 |
| gtt gcg atg ctg gtc atg cgt ttc ttc ctt gga cgc att cag gac aaa Val Ala Met Leu Val Met Arg Phe Phe Leu Gly Arg Ile Gln Asp Lys 250 255 260 | | | 883 |
| cat ggt gac aac ccg gtt att tac ttc ggt ttg atc agc ttc gcc ctc His Gly Asp Asn Pro Val Ile Tyr Phe Gly Leu Ile Ser Phe Ala Leu 265 270 275 | | | 931 |
| gcg ctg ggg ctt atg gct ttg gcg act gaa gac tgg cac att gtt ctc Ala Leu Gly Leu Met Ala Leu Ala Thr Glu Asp Trp His Ile Val Leu 280 285 290 | | | 979 |
| gct ggc gca ctc acc ggt ttg ggc tat ggc acc atc atg ccg gcc gca Ala Gly Ala Leu Thr Gly Leu Gly Tyr Gly Thr Ile Met Pro Ala Ala 295 300 305 | | | 1027 |
| caa gcc att gct gtc gat tca gtt cca agc act cag gtt ggt tcc ggt Gln Ala Ile Ala Val Asp Ser Val Pro Ser Thr Gln Val Gly Ser Gly 310 315 320 325 | | | 1075 |
| att tct acg ctt ttc ctg ttc acc gac atc ggc att ggc tta ggc cca Ile Ser Thr Leu Phe Leu Phe Thr Asp Ile Gly Ile Gly Leu Gly Pro 330 335 340 | | | 1123 |
| atc ctg ctg ggt gga ttg gtt gca gcg acc gga tac aac gtc atg tac Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly Tyr Asn Val Met Tyr 345 350 355 | | | 1171 |
| gca gct ttg gcc gca gtg att gtt gtg gcg ggc gtg ctc tac ctg gtt Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly Val Leu Tyr Leu Val 360 365 370 | | | 1219 |
| gct ttg ggt agg aaa gct agc cac taagtttagag cattttattg agc Ala Leu Gly Arg Lys Ala Ser His 375 380 | | | 1266 |

<210> 178
 <211> 381
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 178
 Val Phe Ile Leu Gly Trp Leu Val Asn Leu Thr Gln Tyr Leu Ser Phe
 1 5 10 15

Tyr Phe Leu Ile Thr Val Met Ala Leu Tyr Ala Met Glu Ser Phe Ala

| 20 | 25 | 30 |
|--|----|----|
| Val Ser Glu Ala Ala Val Gly Phe Ala Ala Ser Ser Phe Val Ile Gly 35 40 45 | | |
| Ala Thr Val Ala Arg Val Phe Ala Gly Trp Thr Ser Asp Arg Phe Gly 50 55 60 | | |
| Lys Lys Gln Ile Leu Leu Ile Phe Val Gly Leu Glu Ala Val Ala Ser 65 70 75 80 | | |
| Leu Phe Tyr Ile Pro Ala Ala Ser Leu Pro Ala Leu Val Ala Val Arg 85 90 95 | | |
| Phe Val His Gly Phe Ser Tyr Ser Leu Ala Ser Thr Ala Val Met Ala 100 105 110 | | |
| Leu Val Gln Ser Val Ile Pro Ala Ser Arg Arg Ala Glu Gly Thr Gly 115 120 125 | | |
| Tyr Phe Ala Leu Gly Ser Thr Leu Ala Thr Ala Phe Gly Pro Ala Ile 130 135 140 | | |
| Ala Leu Phe Val Ile Asp Asp Phe Asn Tyr Asn Thr Leu Phe Trp Ile 145 150 155 160 | | |
| Thr Thr Ala Thr Ser Val Phe Gly Leu Ile Leu Thr Val Leu Ile Arg 165 170 175 | | |
| Lys Pro Glu Phe Ile Lys Asn Ala Glu His Gly Arg Val Lys Pro Val 180 185 190 | | |
| Trp Ser Ile Lys Thr Val Val His Pro Ser Val Met Leu Ile Gly Phe 195 200 205 | | |
| Phe Met Leu Ala Val Gly Leu Ala Tyr Ala Gly Val Ile Thr Phe Leu 210 215 220 | | |
| Asn Gly Phe Ala Gln Asp Thr Gly Leu Thr Ala Gly Ala Gly Leu Phe 225 230 235 240 | | |
| Phe Ile Ala Tyr Ala Val Ala Met Leu Val Met Arg Phe Phe Leu Gly 245 250 255 | | |
| Arg Ile Gln Asp Lys His Gly Asp Asn Pro Val Ile Tyr Phe Gly Leu 260 265 270 | | |
| Ile Ser Phe Ala Leu Ala Leu Gly Leu Met Ala Leu Ala Thr Glu Asp 275 280 285 | | |
| Trp His Ile Val Leu Ala Gly Ala Leu Thr Gly Leu Gly Tyr Gly Thr 290 295 300 | | |
| Ile Met Pro Ala Ala Gln Ala Ile Ala Val Asp Ser Val Pro Ser Thr 305 310 315 320 | | |
| Gln Val Gly Ser Gly Ile Ser Thr Leu Phe Leu Phe Thr Asp Ile Gly | | |

325 330 335
 Ile Gly Leu Gly Pro Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly
 340 345 350
 Tyr Asn Val Met Tyr Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly
 355 360 365
 Val Leu Tyr Leu Val Ala Leu Gly Arg Lys Ala Ser His
 370 375 380

<210> 179
 <211> 914
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (1)..(891)
 <223> FRXA01150

<400> 179
 cca gct gcc tca cta cca gcg ctg gtt gct gtg cgt ttt gtt cac ggt 48
 Pro Ala Ala Ser Leu Pro Ala Leu Val Ala Val Arg Phe Val His Gly
 1 5 10 15
 ttt tct tat tct ctt gct tcc acc gct gtg atg gca ctt gtg cag tcc 96
 Phe Ser Tyr Ser Leu Ala Ser Thr Ala Val Met Ala Leu Val Gln Ser
 20 25 30
 gtg att cct gca agc cgt agg gca gag ggc acc ggc tac ttc gcg ctc 144
 Val Ile Pro Ala Ser Arg Arg Ala Glu Gly Thr Gly Tyr Phe Ala Leu
 35 40 45
 gga tcc aca ctg gct aca gct ttc ggc cca gca att gcg ctg ttt gtt 192
 Gly Ser Thr Leu Ala Thr Ala Phe Gly Pro Ala Ile Ala Leu Phe Val
 50 55 60
 atc gat gac ttc aac tac aac acc ctg ttc tgg att acc act gcg acc 240
 Ile Asp Asp Phe Asn Tyr Asn Thr Leu Phe Trp Ile Thr Thr Ala Thr
 65 70 75 80
 agt gtt ttc ggc ctg atc ctc acc gtt ttg atc cgc aag ccg gag ttc 288
 Ser Val Phe Gly Leu Ile Leu Thr Val Leu Ile Arg Lys Pro Glu Phe
 85 90 95
 att aag aat gcg gaa cac ggc aga gta aag cca gtc tgg tct atc aag 336
 Ile Lys Asn Ala Glu His Gly Arg Val Lys Pro Val Trp Ser Ile Lys
 100 105 110
 act gtt gtg cac cca tcg gtc atg ctc att gga ttc ttc atg ctc gct 384
 Thr Val Val His Pro Ser Val Met Leu Ile Gly Phe Phe Met Leu Ala
 115 120 125
 gtc gga ctg gct tac gca ggc gtg atc acc ttc ctc aac ggc ttc gcg 432
 Val Gly Leu Ala Tyr Ala Gly Val Ile Thr Phe Leu Asn Gly Phe Ala

| 130 | 135 | 140 | |
|---|-----|-----|-----|
| caa gac act ggc ctc acc gcc gga gcg ggt ctt ttc ttt atc gct tat | | | 480 |
| Gln Asp Thr Gly Leu Thr Ala Gly Ala Gly Leu Phe Phe Ile Ala Tyr | | | |
| 145 | 150 | 155 | 160 |
| gcg gtt gcg atg ctg gtc atg cgt ttc ttc ctt gga cgc att cag gac | | | 528 |
| Ala Val Ala Met Leu Val Met Arg Phe Phe Leu Gly Arg Ile Gln Asp | | | |
| | 165 | 170 | 175 |
| aaa cat ggt gac aac ccg gtt att tac ttc ggt ttg atc agc ttc gcc | | | 576 |
| Lys His Gly Asp Asn Pro Val Ile Tyr Phe Gly Leu Ile Ser Phe Ala | | | |
| | 180 | 185 | 190 |
| ctc gcg ctg ggg ctt atg gct ttg gcg act gaa gac tgg cac att gtt | | | 624 |
| Leu Ala Leu Gly Leu Met Ala Leu Ala Thr Glu Asp Trp His Ile Val | | | |
| | 195 | 200 | 205 |
| ctc gct ggc gca ctc acc ggt ttg ggc tat ggc acc atc atg ccg gcc | | | 672 |
| Leu Ala Gly Ala Leu Thr Gly Leu Gly Tyr Gly Thr Ile Met Pro Ala | | | |
| | 210 | 215 | 220 |
| gca caa gcc att gct gtc gat tca gtt cca agc act cag gtt ggt tcc | | | 720 |
| Ala Gln Ala Ile Ala Val Asp Ser Val Pro Ser Thr Gln Val Gly Ser | | | |
| | 225 | 230 | 235 |
| ggt att tct acg ctt ttc ctg ttc acc gac atc ggc att ggc tta ggc | | | 768 |
| Gly Ile Ser Thr Leu Phe Leu Phe Thr Asp Ile Gly Ile Gly Leu Gly | | | |
| | 245 | 250 | 255 |
| cca atc ctg ctg ggt gga ttg gtt gca gcg acc gga tac aac gtc atg | | | 816 |
| Pro Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly Tyr Asn Val Met | | | |
| | 260 | 265 | 270 |
| tac gca gct ttg gcc gca gtg att gtt gtg gcg ggc gtg ctc tac ctg | | | 864 |
| Tyr Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly Val Leu Tyr Leu | | | |
| | 275 | 280 | 285 |
| gtt gct ttg ggt agg aaa gct agc cac taagtttagag cattttattg | | | 911 |
| Val Ala Leu Gly Arg Lys Ala Ser His | | | |
| | 290 | 295 | |
| agc | | | 914 |

<210> 180

<211> 297

<212> PRT

<213> Corynebacterium glutamicum

<400> 180

Pro Ala Ala Ser Leu Pro Ala Leu Val Ala Val Arg Phe Val His Gly
 1 5 10 15

Phe Ser Tyr Ser Leu Ala Ser Thr Ala Val Met Ala Leu Val Gln Ser
 20 25 30

Val Ile Pro Ala Ser Arg Arg Ala Glu Gly Thr Gly Tyr Phe Ala Leu
 35 40 45
 Gly Ser Thr Leu Ala Thr Ala Phe Gly Pro Ala Ile Ala Leu Phe Val
 50 55 60
 Ile Asp Asp Phe Asn Tyr Asn Thr Leu Phe Trp Ile Thr Thr Ala Thr
 65 70 75 80
 Ser Val Phe Gly Leu Ile Leu Thr Val Leu Ile Arg Lys Pro Glu Phe
 85 90 95
 Ile Lys Asn Ala Glu His Gly Arg Val Lys Pro Val Trp Ser Ile Lys
 100 105 110
 Thr Val Val His Pro Ser Val Met Leu Ile Gly Phe Phe Met Leu Ala
 115 120 125
 Val Gly Leu Ala Tyr Ala Gly Val Ile Thr Phe Leu Asn Gly Phe Ala
 130 135 140
 Gln Asp Thr Gly Leu Thr Ala Gly Ala Gly Leu Phe Phe Ile Ala Tyr
 145 150 155 160
 Ala Val Ala Met Leu Val Met Arg Phe Phe Leu Gly Arg Ile Gln Asp
 165 170 175
 Lys His Gly Asp Asn Pro Val Ile Tyr Phe Gly Leu Ile Ser Phe Ala
 180 185 190
 Leu Ala Leu Gly Leu Met Ala Leu Ala Thr Glu Asp Trp His Ile Val
 195 200 205
 Leu Ala Gly Ala Leu Thr Gly Leu Gly Tyr Gly Thr Ile Met Pro Ala
 210 215 220
 Ala Gln Ala Ile Ala Val Asp Ser Val Pro Ser Thr Gln Val Gly Ser
 225 230 235 240
 Gly Ile Ser Thr Leu Phe Leu Phe Thr Asp Ile Gly Ile Gly Leu Gly
 245 250 255
 Pro Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly Tyr Asn Val Met
 260 265 270
 Tyr Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly Val Leu Tyr Leu
 275 280 285
 Val Ala Leu Gly Arg Lys Ala Ser His
 290 295

<210> 181

<211> 1341

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1318)

<223> RXN02964

<400> 181

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aaaattgcat gatgcaataa tttcgattta aaggagaaca gtg tcc gta gct gaa 115
 Val Ser Val Ala Glu
 1 5

gaa ggg aaa ctt ttt aca cca acg ttt gtc atg gga tgg ttt gcc aac 163
 Glu Gly Lys Leu Phe Thr Pro Thr Phe Val Met Gly Trp Phe Ala Asn
 10 15 20

ctt ttc cag ttc ctg gtg ttc tac ttc ctc atc acc acc atg gct ttg 211
 Leu Phe Gln Phe Leu Val Phe Tyr Phe Leu Ile Thr Thr Met Ala Leu
 25 30 35

tac gcc atc aag gaa ttt caa gcc tct gaa gta gaa gct ggc ttc gca 259
 Tyr Ala Ile Lys Glu Phe Gln Ala Ser Glu Val Glu Ala Gly Phe Ala
 40 45 50

tcc agc tca att gtt atc ggc gca gtc ttt tcc agg ttt ttc tcc ggc 307
 Ser Ser Ser Ile Val Ile Gly Ala Val Phe Ser Arg Phe Phe Ser Gly
 55 60 65

tat att att gac cgt ttt ggt cga cgc aag att gtg ctc atc tca gtc 355
 Tyr Ile Ile Asp Arg Phe Gly Arg Arg Lys Ile Val Leu Ile Ser Val
 70 75 80 85

cta gtc act acc att gcg tgt gcc ttg tac ctt ccc atc gaa tca ttg 403
 Leu Val Thr Thr Ile Ala Cys Ala Leu Tyr Leu Pro Ile Glu Ser Leu
 90 95 100

cca ttg cta tac gca aac agg ttc ctc cac ggt gtt gga tac gct ttt 451
 Pro Leu Leu Tyr Ala Asn Arg Phe Leu His Gly Val Gly Tyr Ala Phe
 105 110 115

gct gcc acc gcg atc atg gca atg gtc cag gag ctc att cca gcg tca 499
 Ala Ala Thr Ala Ile Met Ala Met Val Gln Glu Leu Ile Pro Ala Ser
 120 125 130

cga cgt tcc gaa ggt act ggt tac ctg gca ttg ggc act acc gtt tct 547
 Arg Arg Ser Glu Gly Thr Gly Tyr Leu Ala Leu Gly Thr Thr Val Ser
 135 140 145

gca gca ctt gga cca gcc cta gca ctt ttt gtc cta gga aca ttt gat 595
 Ala Ala Leu Gly Pro Ala Leu Ala Leu Phe Val Leu Gly Thr Phe Asp
 150 155 160 165

tac gac atg ctg ttt atc gtg gtc ttg gca acc tcg gtc atc tct ttg 643
 Tyr Asp Met Leu Phe Ile Val Val Leu Ala Thr Ser Val Ile Ser Leu
 170 175 180

atc gcc gtc gtg ttc atg tac ttt aag acc agc gac cct gag cct tct 691

| | | | | | | | | | | | | | | | | | |
|-----|-------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| Ile | Ala | Val | Val | Phe | Met | Tyr | Phe | Lys | Thr | Ser | Asp | Pro | Glu | Pro | Ser | | |
| | | 185 | | | | | | 190 | | | | | 195 | | | | |
| ggg | gaa | cca | gcc | aag | ttc | agc | ttc | aaa | tct | att | atg | aac | cca | aag | atc | 739 | |
| Gly | Glu | Pro | Ala | Lys | Phe | Ser | Phe | Lys | Ser | Ile | Met | Asn | Pro | Lys | Ile | | |
| | | 200 | | | | | 205 | | | | | 210 | | | | | |
| atc | ccc | atc | ggc | atc | ttt | atc | ttg | ctt | att | tgc | ttt | gct | tac | tct | ggc | 787 | |
| Ile | Pro | Ile | Gly | Ile | Phe | Ile | Leu | Leu | Ile | Cys | Phe | Ala | Tyr | Ser | Gly | | |
| | | 215 | | | | 220 | | | | 225 | | | | | | | |
| gtc | att | gcc | tac | atc | aac | gca | ttt | gct | gaa | gaa | cgc | gat | ctg | att | acg | 835 | |
| Val | Ile | Ala | Tyr | Ile | Asn | Ala | Phe | Ala | Glu | Glu | Arg | Asp | Leu | Ile | Thr | | |
| 230 | | | | | 235 | | | | 240 | | | | | | 245 | | |
| ggg | gct | gga | ttg | ttc | ttc | att | gcc | tac | gca | gta | tca | atg | ttt | gtg | atg | 883 | |
| Gly | Ala | Gly | Leu | Phe | Phe | Ile | Ala | Tyr | Ala | Val | Ser | Met | Phe | Val | Met | | |
| | | | 250 | | | | | 255 | | | | | | 260 | | | |
| cgc | agc | ttc | ctt | ggc | aaa | ctg | cag | gac | cgt | cgc | gga | gac | aac | gtc | gtt | 931 | |
| Arg | Ser | Phe | Leu | Gly | Lys | Leu | Gln | Asp | Arg | Arg | Gly | Asp | Asn | Val | Val | | |
| | | 265 | | | | | 270 | | | | | | 275 | | | | |
| att | tac | ttt | gga | ttg | ttc | ttc | ttc | gtt | att | tcc | ttg | acg | att | ttg | tcc | 979 | |
| Ile | Tyr | Phe | Gly | Leu | Phe | Phe | Phe | Val | Ile | Ser | Leu | Thr | Ile | Leu | Ser | | |
| | | 280 | | | | | 285 | | | | | 290 | | | | | |
| ttt | gcc | act | tcc | aac | tgg | cac | gtt | gtg | ttg | tcc | gga | gtc | att | gca | ggg | 1027 | |
| Phe | Ala | Thr | Ser | Asn | Trp | His | Val | Val | Leu | Ser | Gly | Val | Ile | Ala | Gly | | |
| | 295 | | | | | 300 | | | | | 305 | | | | | | |
| ctg | gga | tac | ggc | act | ttg | atg | cca | gca | gtg | cag | tcc | atc | gct | gtt | ggg | 1075 | |
| Leu | Gly | Tyr | Gly | Thr | Leu | Met | Pro | Ala | Val | Gln | Ser | Ile | Ala | Val | Gly | | |
| 310 | | | | | 315 | | | | | 320 | | | | | 325 | | |
| gta | gta | gac | aaa | acc | gaa | ttc | ggg | acg | gcc | ttc | tcc | act | ttg | ttc | ctg | 1123 | |
| Val | Val | Asp | Lys | Thr | Glu | Phe | Gly | Thr | Ala | Phe | Ser | Thr | Leu | Phe | Leu | | |
| | | | 330 | | | | | | 335 | | | | | 340 | | | |
| ttt | gtg | gac | tta | ggg | ttt | ggc | ttt | gga | cct | att | atc | ctg | gga | gca | gtt | 1171 | |
| Phe | Val | Asp | Leu | Gly | Phe | Gly | Phe | Gly | Pro | Ile | Ile | Leu | Gly | Ala | Val | | |
| | | 345 | | | | | | 350 | | | | | 355 | | | | |
| tct | gcg | gca | att | ggg | ttc | gga | cct | atg | tat | gca | gca | ctg | gca | ggg | gtg | 1219 | |
| Ser | Ala | Ala | Ile | Gly | Phe | Gly | Pro | Met | Tyr | Ala | Ala | Leu | Ala | Gly | Val | | |
| | | 360 | | | | | 365 | | | | | 370 | | | | | |
| ggg | gtg | att | gcc | gga | atc | ttc | tac | ctg | ttc | aca | cac | gct | cgc | acc | gat | 1267 | |
| Gly | Val | Ile | Ala | Gly | Ile | Phe | Tyr | Leu | Phe | Thr | His | Ala | Arg | Thr | Asp | | |
| | | 375 | | | | 380 | | | | | 385 | | | | | | |
| cga | gct | aag | aat | ggc | ttt | gtt | aaa | cac | cca | gag | cct | gtc | gct | tta | gtt | 1315 | |
| Arg | Ala | Lys | Asn | Gly | Phe | Val | Lys | His | Pro | Glu | Pro | Val | Ala | Leu | Val | | |
| 390 | | | | 395 | | | | | 400 | | | | | 405 | | | |
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| Ser | | | | | | | | | | | | | | | | | |

<210> 182
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<400> 182

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| Val | Ser | Val | Ala | Glu | Glu | Gly | Lys | Leu | Phe | Thr | Pro | Thr | Phe | Val | Met |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |
| Gly | Trp | Phe | Ala | Asn | Leu | Phe | Gln | Phe | Leu | Val | Phe | Tyr | Phe | Leu | Ile |
| | | | 20 | | | | 25 | | | | | | 30 | | |
| Thr | Thr | Met | Ala | Leu | Tyr | Ala | Ile | Lys | Glu | Phe | Gln | Ala | Ser | Glu | Val |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Glu | Ala | Gly | Phe | Ala | Ser | Ser | Ser | Ile | Val | Ile | Gly | Ala | Val | Phe | Ser |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Arg | Phe | Phe | Ser | Gly | Tyr | Ile | Ile | Asp | Arg | Phe | Gly | Arg | Arg | Lys | Ile |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |
| Val | Leu | Ile | Ser | Val | Leu | Val | Thr | Thr | Ile | Ala | Cys | Ala | Leu | Tyr | Leu |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Pro | Ile | Glu | Ser | Leu | Pro | Leu | Leu | Tyr | Ala | Asn | Arg | Phe | Leu | His | Gly |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Val | Gly | Tyr | Ala | Phe | Ala | Ala | Thr | Ala | Ile | Met | Ala | Met | Val | Gln | Glu |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Leu | Ile | Pro | Ala | Ser | Arg | Arg | Ser | Glu | Gly | Thr | Gly | Tyr | Leu | Ala | Leu |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Gly | Thr | Thr | Val | Ser | Ala | Ala | Leu | Gly | Pro | Ala | Leu | Ala | Leu | Phe | Val |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |
| Leu | Gly | Thr | Phe | Asp | Tyr | Asp | Met | Leu | Phe | Ile | Val | Val | Leu | Ala | Thr |
| | | | 165 | | | | | | 170 | | | | | 175 | |
| Ser | Val | Ile | Ser | Leu | Ile | Ala | Val | Val | Phe | Met | Tyr | Phe | Lys | Thr | Ser |
| | | | 180 | | | | | 185 | | | | | 190 | | |
| Asp | Pro | Glu | Pro | Ser | Gly | Glu | Pro | Ala | Lys | Phe | Ser | Phe | Lys | Ser | Ile |
| | | 195 | | | | | 200 | | | | | 205 | | | |
| Met | Asn | Pro | Lys | Ile | Ile | Pro | Ile | Gly | Ile | Phe | Ile | Leu | Leu | Ile | Cys |
| | 210 | | | | | 215 | | | | | 220 | | | | |
| Phe | Ala | Tyr | Ser | Gly | Val | Ile | Ala | Tyr | Ile | Asn | Ala | Phe | Ala | Glu | Glu |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |
| Arg | Asp | Leu | Ile | Thr | Gly | Ala | Gly | Leu | Phe | Phe | Ile | Ala | Tyr | Ala | Val |
| | | | | 245 | | | | | 250 | | | | | 255 | |

Ser Met Phe Val Met Arg Ser Phe Leu Gly Lys Leu Gln Asp Arg Arg
 260 265 270
 Gly Asp Asn Val Val Ile Tyr Phe Gly Leu Phe Phe Phe Val Ile Ser
 275 280 285
 Leu Thr Ile Leu Ser Phe Ala Thr Ser Asn Trp His Val Val Leu Ser
 290 295 300
 Gly Val Ile Ala Gly Leu Gly Tyr Gly Thr Leu Met Pro Ala Val Gln
 305 310 315 320
 Ser Ile Ala Val Gly Val Val Asp Lys Thr Glu Phe Gly Thr Ala Phe
 325 330 335
 Ser Thr Leu Phe Leu Phe Val Asp Leu Gly Phe Gly Phe Gly Pro Ile
 340 345 350
 Ile Leu Gly Ala Val Ser Ala Ala Ile Gly Phe Gly Pro Met Tyr Ala
 355 360 365
 Ala Leu Ala Gly Val Gly Val Ile Ala Gly Ile Phe Tyr Leu Phe Thr
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 His Ala Arg Thr Asp Arg Ala Lys Asn Gly Phe Val Lys His Pro Glu
 385 390 395 400
 Pro Val Ala Leu Val Ser
 405

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 <223> FRXA02116

<400> 183
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 Val Ser Val Ala Glu
 1 5
 gaa ggg aaa ctt ttt aca cca acg ttt gtc atg gga tgg ttt gcc aac 163
 Glu Gly Lys Leu Phe Thr Pro Thr Phe Val Met Gly Trp Phe Ala Asn
 10 15 20
 ctt ttc cag ttc ctg gtg ttc tac ttc ctc atc acc acc atg gct ttg 211
 Leu Phe Gln Phe Leu Val Phe Tyr Phe Leu Ile Thr Thr Met Ala Leu
 25 30 35
 tac gcc atc aag gaa ttt caa gcc tct gaa gta gaa gct ggc ttc gca 259

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Tyr | Ala | Ile | Lys | Glu | Phe | Gln | Ala | Ser | Glu | Val | Glu | Ala | Gly | Phe | Ala | | |
| | 40 | | | | | | 45 | | | | | 50 | | | | | |
| tcc | agc | tca | att | gtt | atc | ggc | gca | gtc | ttt | tcc | agg | ttt | ttc | tcc | ggc | 307 | |
| Ser | Ser | Ser | Ile | Val | Ile | Gly | Ala | Val | Phe | Ser | Arg | Phe | Phe | Ser | Gly | | |
| | 55 | | | | | 60 | | | 65 | | | | | | | | |
| tat | att | att | gac | cgt | ttt | ggg | cga | cgc | aag | att | gtg | ctc | atc | tca | gtc | 355 | |
| Tyr | Ile | Ile | Asp | Arg | Phe | Gly | Arg | Arg | Lys | Ile | Val | Leu | Ile | Ser | Val | | |
| | 70 | | | | 75 | | | | 80 | | | | | 85 | | | |
| cta | gtc | act | acc | att | gcg | tgt | gcc | ttg | tac | ctt | ccc | atc | gaa | tca | ttg | 403 | |
| Leu | Val | Thr | Thr | Ile | Ala | Cys | Ala | Leu | Tyr | Leu | Pro | Ile | Glu | Ser | Leu | | |
| | | | | 90 | | | | 95 | | | | | 100 | | | | |
| cca | ttg | cta | tac | gca | aac | agg | ttc | ctc | cac | ggg | gtt | gga | tac | gct | ttt | 451 | |
| Pro | Leu | Leu | Tyr | Ala | Asn | Arg | Phe | Leu | His | Gly | Val | Gly | Tyr | Ala | Phe | | |
| | | | 105 | | | | 110 | | | | | 115 | | | | | |
| gct | gcc | acc | gcg | atc | atg | gca | atg | gtc | cag | gag | ctc | att | cca | gcg | tca | 499 | |
| Ala | Ala | Thr | Ala | Ile | Met | Ala | Met | Val | Gln | Glu | Leu | Ile | Pro | Ala | Ser | | |
| | | 120 | | | | 125 | | | | | 130 | | | | | | |
| cga | cgt | tcc | gaa | ggg | act | ggg | tac | ctg | gca | ttg | ggc | act | acc | gtt | tct | 547 | |
| Arg | Arg | Ser | Glu | Gly | Thr | Gly | Tyr | Leu | Ala | Leu | Gly | Thr | Thr | Val | Ser | | |
| | 135 | | | | 140 | | | | | | 145 | | | | | | |
| gca | gca | ctt | gga | cca | gcc | cta | gca | ctt | ttt | gtc | cta | gga | aca | ttt | gat | 595 | |
| Ala | Ala | Leu | Gly | Pro | Ala | Leu | Ala | Leu | Phe | Val | Leu | Gly | Thr | Phe | Asp | | |
| | 150 | | | | 155 | | | | 160 | | | | | 165 | | | |
| tac | gac | atg | ctg | ttt | atc | gtg | gtc | ttg | gca | acc | tcg | gtc | atc | tct | ttg | 643 | |
| Tyr | Asp | Met | Leu | Phe | Ile | Val | Val | Leu | Ala | Thr | Ser | Val | Ile | Ser | Leu | | |
| | | | 170 | | | | | 175 | | | | | | 180 | | | |
| atc | gcc | gtc | gtg | ttc | atg | tac | ttt | aag | acc | agc | gac | cct | gag | cct | tct | 691 | |
| Ile | Ala | Val | Val | Phe | Met | Tyr | Phe | Lys | Thr | Ser | Asp | Pro | Glu | Pro | Ser | | |
| | | | 185 | | | | 190 | | | | | 195 | | | | | |
| ggg | gaa | cca | gcc | aag | ttc | agc | ttc | aaa | tct | att | atg | aac | cca | aag | atc | 739 | |
| Gly | Glu | Pro | Ala | Lys | Phe | Ser | Phe | Lys | Ser | Ile | Met | Asn | Pro | Lys | Ile | | |
| | 200 | | | | 205 | | | | | | 210 | | | | | | |
| atc | ccc | atc | ggc | atc | ttt | atc | ttg | ctt | att | tgc | ttt | gct | tac | tct | ggc | 787 | |
| Ile | Pro | Ile | Gly | Ile | Phe | Ile | Leu | Leu | Ile | Cys | Phe | Ala | Tyr | Ser | Gly | | |
| | 215 | | | | 220 | | | | | 225 | | | | | | | |
| gtc | att | gcc | tac | atc | aac | gca | ttt | gct | gaa | gaa | cgc | gat | ctg | att | acg | 835 | |
| Val | Ile | Ala | Tyr | Ile | Asn | Ala | Phe | Ala | Glu | Glu | Arg | Asp | Leu | Ile | Thr | | |
| | 230 | | | | 235 | | | | 240 | | | | 245 | | | | |
| ggg | gct | gga | ttg | ttc | ttc | att | gcc | tac | gca | gta | tca | atg | ttt | gtg | atg | 883 | |
| Gly | Ala | Gly | Leu | Phe | Phe | Ile | Ala | Tyr | Ala | Val | Ser | Met | Phe | Val | Met | | |
| | | | 250 | | | | 255 | | | | | | 260 | | | | |
| cgc | agc | ttc | ctt | ggc | aaa | ctg | cag | gac | cgt | cgc | gga | gac | aac | gtc | gtt | 931 | |
| Arg | Ser | Phe | Leu | Gly | Lys | Leu | Gln | Asp | Arg | Arg | Gly | Asp | Asn | Val | Val | | |

265 270 275

att tac ttt gga ttg ttc ttc ttc gtt att tcc ttg acg att ttg tcc 979
 Ile Tyr Phe Gly Leu Phe Phe Phe Val Ile Ser Leu Thr Ile Leu Ser
 280 285 290

ttt gcc act tcc aac tgg cac gtt gtg 1006
 Phe Ala Thr Ser Asn Trp His Val Val
 295 300

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 <213> Corynebacterium glutamicum

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Thr Thr Met Ala Leu Tyr Ala Ile Lys Glu Phe Gln Ala Ser Glu Val
 35 40 45

Glu Ala Gly Phe Ala Ser Ser Ser Ile Val Ile Gly Ala Val Phe Ser
 50 55 60

Arg Phe Phe Ser Gly Tyr Ile Ile Asp Arg Phe Gly Arg Arg Lys Ile
 65 70 75 80

Val Leu Ile Ser Val Leu Val Thr Thr Ile Ala Cys Ala Leu Tyr Leu
 85 90 95

Pro Ile Glu Ser Leu Pro Leu Leu Tyr Ala Asn Arg Phe Leu His Gly
 100 105 110

Val Gly Tyr Ala Phe Ala Ala Thr Ala Ile Met Ala Met Val Gln Glu
 115 120 125

Leu Ile Pro Ala Ser Arg Arg Ser Glu Gly Thr Gly Tyr Leu Ala Leu
 130 135 140

Gly Thr Thr Val Ser Ala Ala Leu Gly Pro Ala Leu Ala Leu Phe Val
 145 150 155 160

Leu Gly Thr Phe Asp Tyr Asp Met Leu Phe Ile Val Val Leu Ala Thr
 165 170 175

Ser Val Ile Ser Leu Ile Ala Val Val Phe Met Tyr Phe Lys Thr Ser
 180 185 190

Asp Pro Glu Pro Ser Gly Glu Pro Ala Lys Phe Ser Phe Lys Ser Ile
 195 200 205

Met Asn Pro Lys Ile Ile Pro Ile Gly Ile Phe Ile Leu Leu Ile Cys

| | | | |
|---|-----|-----|-----|
| 210 | 215 | 220 | |
| Phe Ala Tyr Ser Gly Val Ile Ala Tyr Ile Asn Ala Phe Ala Glu Glu | | | |
| 225 | 230 | 235 | 240 |
| Arg Asp Leu Ile Thr Gly Ala Gly Leu Phe Phe Ile Ala Tyr Ala Val | | | |
| | 245 | 250 | 255 |
| Ser Met Phe Val Met Arg Ser Phe Leu Gly Lys Leu Gln Asp Arg Arg | | | |
| | 260 | 265 | 270 |
| Gly Asp Asn Val Val Ile Tyr Phe Gly Leu Phe Phe Phe Val Ile Ser | | | |
| | 275 | 280 | 285 |
| Leu Thr Ile Leu Ser Phe Ala Thr Ser Asn Trp His Val Val | | | |
| | 290 | 295 | 300 |

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 <223> RXA00858

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 tcttaaattg tctaaccaag aaccggaggt tctttttgtc atg gaa gta aac tta 115
 Met Glu Val Asn Leu
 1 5
 gcc aca tgg cta atc act atc gca gtg att gct ggc ttc ttc att ttc 163
 Ala Thr Trp Leu Ile Thr Ile Ala Val Ile Ala Gly Phe Phe Ile Phe
 10 15 20
 gat ttc tat tcc cac gtc cgc acc cca cac gag ccc act atc aaa gaa 211
 Asp Phe Tyr Ser His Val Arg Thr Pro His Glu Pro Thr Ile Lys Glu
 25 30 35
 tcc gca tgg tgg agc ctc ttc tac gta gcc ctc gcc tgt gtt ttc ggc 259
 Ser Ala Trp Trp Ser Leu Phe Tyr Val Ala Leu Ala Cys Val Phe Gly
 40 45 50
 gtg ttc ctc tgg ttt gct tgg ggc gag cca ggt aac cca cac cag cac 307
 Val Phe Leu Trp Phe Ala Trp Gly Glu Pro Gly Asn Pro His Gln His
 55 60 65
 ggc att gag ttc ttc acc ggt tac gtg aca gag aag gcg ttg agt gtt 355
 Gly Ile Glu Phe Phe Thr Gly Tyr Val Thr Glu Lys Ala Leu Ser Val
 70 75 80 85
 gat aac ctc ttc atc ttc gcg ctg atc atg ggt tct ttc aag att cct 403
 Asp Asn Leu Phe Ile Phe Ala Leu Ile Met Gly Ser Phe Lys Ile Pro

| | 90 | 95 | 100 | |
|---|-----|-----|-----|-----|
| cgc aag tac cag cag aag gtt ctg ctc atc ggt atc gcg ctg gca ctg | | | | 451 |
| Arg Lys Tyr Gln Gln Lys Val Leu Leu Ile Gly Ile Ala Leu Ala Leu | | | | |
| | 105 | 110 | 115 | |
| gtc ttc cgc ctg gca ttc atc ctc gca ggt gct gca gtt atc gaa gcc | | | | 499 |
| Val Phe Arg Leu Ala Phe Ile Leu Ala Gly Ala Ala Val Ile Glu Ala | | | | |
| | 120 | 125 | 130 | |
| tgg tcc gat gtc ttc tac atc ttc tcc atc tgg ctg atc tac acc gct | | | | 547 |
| Trp Ser Asp Val Phe Tyr Ile Phe Ser Ile Trp Leu Ile Tyr Thr Ala | | | | |
| | 135 | 140 | 145 | |
| gtg aag gct cct gtg cac gag | | | | 568 |
| Val Lys Ala Pro Val His Glu | | | | |
| | 150 | 155 | | |

<210> 186

<211> 156

<212> PRT

<213> Corynebacterium glutamicum

<400> 186

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| 1 | 5 | 10 | 15 |
| Gly Phe Phe Ile Phe Asp Phe Tyr Ser His Val Arg Thr Pro His Glu | | | |
| 20 | 25 | 30 | |
| Pro Thr Ile Lys Glu Ser Ala Trp Trp Ser Leu Phe Tyr Val Ala Leu | | | |
| 35 | 40 | 45 | |
| Ala Cys Val Phe Gly Val Phe Leu Trp Phe Ala Trp Gly Glu Pro Gly | | | |
| 50 | 55 | 60 | |
| Asn Pro His Gln His Gly Ile Glu Phe Phe Thr Gly Tyr Val Thr Glu | | | |
| 65 | 70 | 75 | 80 |
| Lys Ala Leu Ser Val Asp Asn Leu Phe Ile Phe Ala Leu Ile Met Gly | | | |
| 85 | 90 | 95 | |
| Ser Phe Lys Ile Pro Arg Lys Tyr Gln Gln Lys Val Leu Leu Ile Gly | | | |
| 100 | 105 | 110 | |
| Ile Ala Leu Ala Leu Val Phe Arg Leu Ala Phe Ile Leu Ala Gly Ala | | | |
| 115 | 120 | 125 | |
| Ala Val Ile Glu Ala Trp Ser Asp Val Phe Tyr Ile Phe Ser Ile Trp | | | |
| 130 | 135 | 140 | |
| Leu Ile Tyr Thr Ala Val Lys Ala Pro Val His Glu | | | |
| 145 | 150 | 155 | |

<210> 187

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<220>
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 <222> (101)..(952)
 <223> RXA02305

<400> 187

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caaacgatga cttcgatccc gaaaagtgga ggaacatgta atg cca gcc ttt gag 115
                                   Met Pro Ala Phe Glu
                                   1                               5

gca atg cca gga atg ccg tat tgg atc gac ctg tcc acc tcg gac att 163
Ala Met Pro Gly Met Pro Tyr Trp Ile Asp Leu Ser Thr Ser Asp Ile
                                   10                               15                               20

gca aaa tct gca cac ttc tac gaa aac gtt ctc ggc tgg gaa att gaa 211
Ala Lys Ser Ala His Phe Tyr Glu Asn Val Leu Gly Trp Glu Ile Glu
                                   25                               30                               35

gaa gtc aac gat ggc tac cgc atg gct cgt ctg cag gga cta ccc gtg 259
Glu Val Asn Asp Gly Tyr Arg Met Ala Arg Leu Gln Gly Leu Pro Val
                                   40                               45                               50

gca ggg ctg atc gat cag cgc ggt gaa tca agc atc ccg gat acc tgg 307
Ala Gly Leu Ile Asp Gln Arg Gly Glu Ser Ser Ile Pro Asp Thr Trp
                                   55                               60                               65

att acc tac ttc ctc tcc tac gat ctg gat gcc act gca aag aag atc 355
Ile Thr Tyr Phe Leu Ser Tyr Asp Leu Asp Ala Thr Ala Lys Lys Ile
                                   70                               75                               80                               85

gca gaa ctg ggt gga cga att ctg gcc gag cca act gac gtg cac ttg 403
Ala Glu Leu Gly Gly Arg Ile Leu Ala Glu Pro Thr Asp Val His Leu
                                   90                               95                               100

gga cgc atg atc cta gct gtt gat act gcc ggc gca ctg ttc ggc gtt 451
Gly Arg Met Ile Leu Ala Val Asp Thr Ala Gly Ala Leu Phe Gly Val
                                   105                               110                               115

att gag cca ggc agc gag gaa tca ttc gtc gct gct ggt gaa cca ggc 499
Ile Glu Pro Gly Ser Glu Glu Ser Phe Val Ala Ala Gly Glu Pro Gly
                                   120                               125                               130

aca tcc gtg tgg cat gaa ctc acc act gtc tcc aaa tat tcc gaa gct 547
Thr Ser Val Trp His Glu Leu Thr Thr Val Ser Lys Tyr Ser Glu Ala
                                   135                               140                               145

atc gat ttc tac ggt gag ctg ttc act tgg aca acc tct gaa atg gct 595
Ile Asp Phe Tyr Gly Glu Leu Phe Thr Trp Thr Thr Ser Glu Met Ala
150                               155                               160                               165

agt gct gaa gac gat agt ttc cgc tac acc acc gca ttg gct gac ggt 643
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Ser Ala Glu Asp Asp Ser Phe Arg Tyr Thr Thr Ala Leu Ala Asp Gly
 170 175 180

tcc gcc ttt gct gga att ttt gat gcc aaa ggc cac ttc cca cct cag 691
 Ser Ala Phe Ala Gly Ile Phe Asp Ala Lys Gly His Phe Pro Pro Gln
 185 190 195

gtt cca agc ttc tgg cag tcc tac ctt ggc gtg ctc aac gcc gat gat 739
 Val Pro Ser Phe Trp Gln Ser Tyr Leu Gly Val Leu Asn Ala Asp Asp
 200 205 210

gct gca gcg aag gcc aag gaa ttt ggt ggc gat gtt att cgt aag cca 787
 Ala Ala Ala Lys Ala Lys Glu Phe Gly Gly Asp Val Ile Arg Lys Pro
 215 220 225

tgg gac tca gaa ttt ggc cgc atg gtt ctc atc tct gat tcc act ggt 835
 Trp Asp Ser Glu Phe Gly Arg Met Val Leu Ile Ser Asp Ser Thr Gly
 230 235 240 245

gcc aca att acc ttg tgt gaa gta gag gaa tac gtc gag gaa gca gca 883
 Ala Thr Ile Thr Leu Cys Glu Val Glu Glu Tyr Val Glu Glu Ala Ala
 250 255 260

gaa ggc gat gat ctc ttc gac atc gat ctc agt gct ttc gaa gag cag 931
 Glu Gly Asp Asp Leu Phe Asp Ile Asp Leu Ser Ala Phe Glu Glu Gln
 265 270 275

ttc cgc aag caa gaa gga cag taatcctaca gcgccatgga gga 975
 Phe Arg Lys Gln Glu Gly Gln
 280

<210> 188

<211> 284

<212> PRT

<213> Corynebacterium glutamicum

<400> 188

Met Pro Ala Phe Glu Ala Met Pro Gly Met Pro Tyr Trp Ile Asp Leu
 1 5 10 15

Ser Thr Ser Asp Ile Ala Lys Ser Ala His Phe Tyr Glu Asn Val Leu
 20 25 30

Gly Trp Glu Ile Glu Glu Val Asn Asp Gly Tyr Arg Met Ala Arg Leu
 35 40 45

Gln Gly Leu Pro Val Ala Gly Leu Ile Asp Gln Arg Gly Glu Ser Ser
 50 55 60

Ile Pro Asp Thr Trp Ile Thr Tyr Phe Leu Ser Tyr Asp Leu Asp Ala
 65 70 75 80

Thr Ala Lys Lys Ile Ala Glu Leu Gly Gly Arg Ile Leu Ala Glu Pro
 85 90 95

Thr Asp Val His Leu Gly Arg Met Ile Leu Ala Val Asp Thr Ala Gly

| 100 | 105 | 110 |
|---|-----|---------|
| Ala Leu Phe Gly Val Ile Glu Pro Gly Ser Glu Glu Ser Phe Val Ala | | |
| 115 | 120 | 125 |
| Ala Gly Glu Pro Gly Thr Ser Val Trp His Glu Leu Thr Thr Val Ser | | |
| 130 | 135 | 140 |
| Lys Tyr Ser Glu Ala Ile Asp Phe Tyr Gly Glu Leu Phe Thr Trp Thr | | |
| 145 | 150 | 155 160 |
| Thr Ser Glu Met Ala Ser Ala Glu Asp Asp Ser Phe Arg Tyr Thr Thr | | |
| 165 | 170 | 175 |
| Ala Leu Ala Asp Gly Ser Ala Phe Ala Gly Ile Phe Asp Ala Lys Gly | | |
| 180 | 185 | 190 |
| His Phe Pro Pro Gln Val Pro Ser Phe Trp Gln Ser Tyr Leu Gly Val | | |
| 195 | 200 | 205 |
| Leu Asn Ala Asp Asp Ala Ala Ala Lys Ala Lys Glu Phe Gly Gly Asp | | |
| 210 | 215 | 220 |
| Val Ile Arg Lys Pro Trp Asp Ser Glu Phe Gly Arg Met Val Leu Ile | | |
| 225 | 230 | 235 240 |
| Ser Asp Ser Thr Gly Ala Thr Ile Thr Leu Cys Glu Val Glu Glu Tyr | | |
| 245 | 250 | 255 |
| Val Glu Glu Ala Ala Glu Gly Asp Asp Leu Phe Asp Ile Asp Leu Ser | | |
| 260 | 265 | 270 |
| Ala Phe Glu Glu Gln Phe Arg Lys Gln Glu Gly Gln | | |
| 275 | 280 | |

<210> 189
 <211> 948
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(925)
 <223> RXA00084

<400> 189
 tcacccttgt cgataccagc tactgggtat ctggcgtcgg tccacttggc ggcagcaaag 60
 tcttggaaga catcgatgcc ttcctcgacg cacagcaata atg tcc aca gct ctc 115
 Met Ser Thr Ala Leu
 1 5
 ccc gat cag ctc aag tgg gaa tac agt gcc ttc ccc gtg cag atc tcg 163
 Pro Asp Gln Leu Lys Trp Glu Tyr Ser Ala Phe Pro Val Gln Ile Ser
 10 15 20

| | |
|---|-----|
| cag aag caa cgg ctt agt ccc ggc ttc atg cgg atc acc gtc act ggt | 211 |
| Gln Lys Gln Arg Leu Ser Pro Gly Phe Met Arg Ile Thr Val Thr Gly | |
| 25 30 35 | |
| gac aag ctc cga ttc ttt ggc cag tgg ggt ttg gac caa cgc atc aaa | 259 |
| Asp Lys Leu Arg Phe Phe Gly Gln Trp Gly Leu Asp Gln Arg Ile Lys | |
| 40 45 50 | |
| ctg atc att cca agc ccg gct ggg aac atc cca gat ttc gga att ctc | 307 |
| Leu Ile Ile Pro Ser Pro Ala Gly Asn Ile Pro Asp Phe Gly Ile Leu | |
| 55 60 65 | |
| gac gaa ccc act ccc cca ccg aca acg tgg ctt cct cgt gct aag tct | 355 |
| Asp Glu Pro Thr Pro Pro Pro Thr Thr Trp Leu Pro Arg Ala Lys Ser | |
| 70 75 80 85 | |
| ttt cca gcg gac caa cga ccg atc ttg cgc acc tac acc cca tct gcg | 403 |
| Phe Pro Ala Asp Gln Arg Pro Ile Leu Arg Thr Tyr Thr Pro Ser Ala | |
| 90 95 100 | |
| gtc cga ccc gaa cta tgc gaa gta gac att gat atc tat ctt cac aac | 451 |
| Val Arg Pro Glu Leu Cys Glu Val Asp Ile Asp Ile Tyr Leu His Asn | |
| 105 110 115 | |
| cct tcg gga cca gta tcc aga tgg gca aag aac tgc agt gtt gac gat | 499 |
| Pro Ser Gly Pro Val Ser Arg Trp Ala Lys Asn Cys Ser Val Asp Asp | |
| 120 125 130 | |
| gaa cta atc atc acc ggc cct gac gta cgc gca gga gaa acc ggc tac | 547 |
| Glu Leu Ile Ile Thr Gly Pro Asp Val Arg Ala Gly Glu Thr Gly Tyr | |
| 135 140 145 | |
| gga atc acc tat cat ccg act tct gcg atc gat cgc ctc tgt ctc atc | 595 |
| Gly Ile Thr Tyr His Pro Thr Ser Ala Ile Asp Arg Leu Cys Leu Ile | |
| 150 155 160 165 | |
| ggc gat tgt gca tca gct ccc gcg atc gca aat atc gtc aat caa tca | 643 |
| Gly Asp Cys Ala Ser Ala Pro Ala Ile Ala Asn Ile Val Asn Gln Ser | |
| 170 175 180 | |
| aaa gta cct act acg gtt ttc ctc cac gta gac agc cta gaa gat gat | 691 |
| Lys Val Pro Thr Thr Val Phe Leu His Val Asp Ser Leu Glu Asp Asp | |
| 185 190 195 | |
| gta ttg atc gcc gat agc tcc acc aag ctc act ttc gaa gac atc gac | 739 |
| Val Leu Ile Ala Asp Ser Ser Thr Lys Leu Thr Phe Glu Asp Ile Asp | |
| 200 205 210 | |
| gct tac aaa gca aag gtc ttc caa tgg gct tca gcc aat gca gca gat | 787 |
| Ala Tyr Lys Ala Lys Val Phe Gln Trp Ala Ser Ala Asn Ala Ala Asp | |
| 215 220 225 | |
| cct tca gta cac ttc tgg atc gcc ggt gaa act agc atg gtg cgc ttc | 835 |
| Pro Ser Val His Phe Trp Ile Ala Gly Glu Thr Ser Met Val Arg Phe | |
| 230 235 240 245 | |
| att cgc aaa gaa cta atc aac agc tac cga gtt gat tcc tca cga atc | 883 |

Ile Arg Lys Glu Leu Ile Asn Ser Tyr Arg Val Asp Ser Ser Arg Ile
 250 255 260

act ttc ctc ggc tac tgg aaa tac ggc cga cga acc gta gac 925
 Thr Phe Leu Gly Tyr Trp Lys Tyr Gly Arg Arg Thr Val Asp
 265 270 275

tagctttcag attcagaccc cag 948

<210> 190

<211> 275

<212> PRT

<213> Corynebacterium glutamicum

<400> 190

Met Ser Thr Ala Leu Pro Asp Gln Leu Lys Trp Glu Tyr Ser Ala Phe
 1 5 10 15

Pro Val Gln Ile Ser Gln Lys Gln Arg Leu Ser Pro Gly Phe Met Arg
 20 25 30

Ile Thr Val Thr Gly Asp Lys Leu Arg Phe Phe Gly Gln Trp Gly Leu
 35 40 45

Asp Gln Arg Ile Lys Leu Ile Ile Pro Ser Pro Ala Gly Asn Ile Pro
 50 55 60

Asp Phe Gly Ile Leu Asp Glu Pro Thr Pro Pro Thr Thr Trp Leu
 65 70 75 80

Pro Arg Ala Lys Ser Phe Pro Ala Asp Gln Arg Pro Ile Leu Arg Thr
 85 90 95

Tyr Thr Pro Ser Ala Val Arg Pro Glu Leu Cys Glu Val Asp Ile Asp
 100 105 110

Ile Tyr Leu His Asn Pro Ser Gly Pro Val Ser Arg Trp Ala Lys Asn
 115 120 125

Cys Ser Val Asp Asp Glu Leu Ile Ile Thr Gly Pro Asp Val Arg Ala
 130 135 140

Gly Glu Thr Gly Tyr Gly Ile Thr Tyr His Pro Thr Ser Ala Ile Asp
 145 150 155 160

Arg Leu Cys Leu Ile Gly Asp Cys Ala Ser Ala Pro Ala Ile Ala Asn
 165 170 175

Ile Val Asn Gln Ser Lys Val Pro Thr Thr Val Phe Leu His Val Asp
 180 185 190

Ser Leu Glu Asp Asp Val Leu Ile Ala Asp Ser Ser Thr Lys Leu Thr
 195 200 205

Phe Glu Asp Ile Asp Ala Tyr Lys Ala Lys Val Phe Gln Trp Ala Ser
 210 215 220

Ala Asn Ala Ala Asp Pro Ser Val His Phe Trp Ile Ala Gly Glu Thr
225 230 235 240

Ser Met Val Arg Phe Ile Arg Lys Glu Leu Ile Asn Ser Tyr Arg Val
245 250 255

Asp Ser Ser Arg Ile Thr Phe Leu Gly Tyr Trp Lys Tyr Gly Arg Arg
260 265 270

Thr Val Asp
275

<210> 191

<211> 468

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(445)

<223> RXA00843

<400> 191

gccctgatgc gaaaccggcg ccaacaatga tgccgacgaa ggcaaatgcc actcttagga 60

tttgaataat catggaacaa accttagtag gctcaacgtt atg aaa gtc acg att 115
Met Lys Val Thr Ile
1 5

ttc cat aat ccg cgt tgt tcc aca tcc aga aat acc ctc gct tac ctc 163
Phe His Asn Pro Arg Cys Ser Thr Ser Arg Asn Thr Leu Ala Tyr Leu
10 15 20

cgc gac aag gac att gag cct gaa att gtt cag tat ctc aaa gac acg 211
Arg Asp Lys Asp Ile Glu Pro Glu Ile Val Gln Tyr Leu Lys Asp Thr
25 30 35

ccc acc gct tcc gag ctc aaa gaa cta ttc aat acg ctg gga att cca 259
Pro Thr Ala Ser Glu Leu Lys Glu Leu Phe Asn Thr Leu Gly Ile Pro
40 45 50

gtc cac gac ggc atc aga acc cgc gaa gct gag tac aca gaa ctg ggc 307
Val His Asp Gly Ile Arg Thr Arg Glu Ala Glu Tyr Thr Glu Leu Gly
55 60 65

ctg tca cca gaa aca cct gaa act gag ctt atc gac gcc atc gtt gcc 355
Leu Ser Pro Glu Thr Pro Glu Thr Glu Leu Ile Asp Ala Ile Val Ala
70 75 80 85

cat ccc agg ctc ctt cag cgt ccg atc gtg gtg acg gcc aaa ggc gcg 403
His Pro Arg Leu Leu Gln Arg Pro Ile Val Val Thr Ala Lys Gly Ala
90 95 100

cgc att gcg cgc ccc aaa atc gac gtc att gac agc atc ttg 445
Arg Ile Ala Arg Pro Lys Ile Asp Val Ile Asp Ser Ile Leu

105

110

115

tgacaacatt ttgtagagca acc

468

<210> 192

<211> 115

<212> PRT

<213> Corynebacterium glutamicum

<400> 192

Met Lys Val Thr Ile Phe His Asn Pro Arg Cys Ser Thr Ser Arg Asn
 1 5 10 15

Thr Leu Ala Tyr Leu Arg Asp Lys Asp Ile Glu Pro Glu Ile Val Gln
 20 25 30

Tyr Leu Lys Asp Thr Pro Thr Ala Ser Glu Leu Lys Glu Leu Phe Asn
 35 40 45

Thr Leu Gly Ile Pro Val His Asp Gly Ile Arg Thr Arg Glu Ala Glu
 50 55 60

Tyr Thr Glu Leu Gly Leu Ser Pro Glu Thr Pro Glu Thr Glu Leu Ile
 65 70 75 80

Asp Ala Ile Val Ala His Pro Arg Leu Leu Gln Arg Pro Ile Val Val
 85 90 95

Thr Ala Lys Gly Ala Arg Ile Ala Arg Pro Lys Ile Asp Val Ile Asp
 100 105 110

Ser Ile Leu
 115

<210> 193

<211> 432

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(409)

<223> RXA01052

<400> 193

tatggccaac cctaggggga tggcctgtgt gttcactggt aggtttcctc aaaatcttta 60

acgaacaacg aagagcttgc ccgagagtat cttgggtcgc atg gac aca aaa tta 115
 Met Asp Thr Lys Leu
 1 5

ggc gct gaa ttg ggt act gaa ttt gat ctc att gtt gtt ggt ttc ggc 163
 Gly Ala Glu Leu Gly Thr Glu Phe Asp Leu Ile Val Val Gly Phe Gly
 10 15 20


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aaa gca ggc aag act atc gcg atg aaa cgc tcg gca gcg ggg gat aag 211
Lys Ala Gly Lys Thr Ile Ala Met Lys Arg Ser Ala Ala Gly Asp Lys
      25              30              35

gtc gca ctg atc gag cag agt cca cag atg tat ggc ggt acc tgc atc 259
Val Ala Leu Ile Glu Gln Ser Pro Gln Met Tyr Gly Gly Thr Cys Ile
      40              45              50

aat gta ggt tgc atc ccc acg aag aag ttg ttg ttt gag act gca acg 307
Asn Val Gly Cys Ile Pro Thr Lys Lys Leu Leu Phe Glu Thr Ala Thr
      55              60              65

ggc aag gat ttc ccg gat gcg gtt gtg gcg cgt gat cag ttg att ggc 355
Gly Lys Asp Phe Pro Asp Ala Val Val Ala Arg Asp Gln Leu Ile Gly
      70              75              80              85

aag ctg aat gcc aag aat ctt gcg atg gcc aca gac aag ggt gtc acc 403
Lys Leu Asn Ala Lys Asn Leu Ala Met Ala Thr Asp Lys Gly Val Thr
      90              95              100

cgt cat tgatggaaaa gctacgttta cag 432
Arg His

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<210> 194
 <211> 103
 <212> PRT
 <213> Corynebacterium glutamicum

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<400> 194
Met Asp Thr Lys Leu Gly Ala Glu Leu Gly Thr Glu Phe Asp Leu Ile
  1              5              10              15

Val Val Gly Phe Gly Lys Ala Gly Lys Thr Ile Ala Met Lys Arg Ser
      20              25              30

Ala Ala Gly Asp Lys Val Ala Leu Ile Glu Gln Ser Pro Gln Met Tyr
      35              40              45

Gly Gly Thr Cys Ile Asn Val Gly Cys Ile Pro Thr Lys Lys Leu Leu
      50              55              60

Phe Glu Thr Ala Thr Gly Lys Asp Phe Pro Asp Ala Val Val Ala Arg
      65              70              75              80

Asp Gln Leu Ile Gly Lys Leu Asn Ala Lys Asn Leu Ala Met Ala Thr
      85              90              95

Asp Lys Gly Val Thr Arg His
      100

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<210> 195
 <211> 543
 <212> DNA
 <213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(520)

<223> RXA01053

<400> 195

ttgcgatggc cacagacaag ggtgtcaccc gtcattgatg gaaaagctac gtttacagct 60

agccacgaaa tcacaagtaa cttcaggtag tgacactctt gtg ctg tat gcg cca 115
 Val Leu Tyr Ala Pro
 1 5

acg att gtg atc aac acg ggc tcc acg ccg gtc atc ccc aat gtc cca 163
 Thr Ile Val Ile Asn Thr Gly Ser Thr Pro Val Ile Pro Asn Val Pro
 10 15 20

ggc acc gac aat ccg cat gtt ttt gat tcc act ggc att cag cac att 211
 Gly Thr Asp Asn Pro His Val Phe Asp Ser Thr Gly Ile Gln His Ile
 25 30 35

tcg ccc ctg ccg aag cac ctc gcg atc atc ggc ggt ggc ccc atc ggt 259
 Ser Pro Leu Pro Lys His Leu Ala Ile Ile Gly Gly Gly Pro Ile Gly
 40 45 50

ttg gaa ttt gcc acg ctt ttc agt gga caa ggc tcc aaa gtc acc atc 307
 Leu Glu Phe Ala Thr Leu Phe Ser Gly Gln Gly Ser Lys Val Thr Ile
 55 60 65

atc gac cgt ggt gaa ttg ccg ctg aaa aat ttc gac agg gaa gta gcg 355
 Ile Asp Arg Gly Glu Leu Pro Leu Lys Asn Phe Asp Arg Glu Val Ala
 70 75 80 85

gag ctg gcc aaa acc gac ctg gag gcc cgc gga atc acc ttc ctc aac 403
 Glu Leu Ala Lys Thr Asp Leu Glu Ala Arg Gly Ile Thr Phe Leu Asn
 90 95 100

aac gct gaa ctc acc gga ttc agc ggt gac ctc acc atc gcg ctc aaa 451
 Asn Ala Glu Leu Thr Gly Phe Ser Gly Asp Leu Thr Ile Ala Leu Lys
 105 110 115

gac cac gac ctc ctc gcc gac gcc gca ctt ttt gca tcg gcc gac gcc 499
 Asp His Asp Leu Leu Ala Asp Ala Ala Leu Phe Ala Ser Ala Asp Ala
 120 125 130

cgg cac cga cgg gct cgg cct tgaacaggcg ggcatcaaaa cag 543
 Arg His Arg Arg Ala Arg Pro
 135 140

<210> 196

<211> 140

<212> PRT

<213> Corynebacterium glutamicum

<400> 196

Val Leu Tyr Ala Pro Thr Ile Val Ile Asn Thr Gly Ser Thr Pro Val

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<400> 197
gacctctctcg ccgacgccgc acttttttgca tcggccgacg cccggcaccg acgggctcgg 60
ccttgaacag gcgggcatca aaacaggcac gcgtggggag gtg ctt gtc gac gcc 115
                                   Val Leu Val Asp Ala
                                   1                               5
cac ctc cgg acc aac atc gac ggc atc ttc gct gta ggt gat gtc aat 163
His Leu Arg Thr Asn Ile Asp Gly Ile Phe Ala Val Gly Asp Val Asn
                10                        15                        20
ggc ggc ccg cag ttt acc tac gtg tcc tac gat gac cac cgc att gtg 211
Gly Gly Pro Gln Phe Thr Tyr Val Ser Tyr Asp Asp His Arg Ile Val
                25                        30                        35
ctg gat caa cta gcc gga aca ggt aag aaa tcc att gca cac cga ctg 259
Leu Asp Gln Leu Ala Gly Thr Gly Lys Lys Ser Ile Ala His Arg Leu
                40                        45                        50
atc ccc acc acc acg ttc atc gaa ccg ccg tta tcc acc atc ggt gac 307

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Ile Pro Thr Thr Thr Phe Ile Glu Pro Pro Leu Ser Thr Ile Gly Asp
 55 60 65
 aac act gaa ggg gaa aat gtg gtg gtg aaa aag gcc ttg att gca gat 355
 Asn Thr Glu Gly Glu Asn Val Val Val Lys Lys Ala Leu Ile Ala Asp
 70 75 80 85
 atg ccg atc gtt ccc cga cca gag att att aac caa cct cac ggt atg 403
 Met Pro Ile Val Pro Arg Pro Glu Ile Ile Asn Gln Pro His Gly Met
 90 95 100
 gtg aag ttt ttc gtc gac aag caa tct gat gcg ctg ctc ggc gcg acc 451
 Val Lys Phe Phe Val Asp Lys Gln Ser Asp Ala Leu Leu Gly Ala Thr
 105 110 115
 ttg tac tgc gcc gac tcc cag gag ctc atc aac acc gtg gcg ctt gcc 499
 Leu Tyr Cys Ala Asp Ser Gln Glu Leu Ile Asn Thr Val Ala Leu Ala
 120 125 130
 atg cgg cat ggc gtc acc gcc tcc gag ctt ggc gac ggc atc tac acc 547
 Met Arg His Gly Val Thr Ala Ser Glu Leu Gly Asp Gly Ile Tyr Thr
 135 140 145
 cac ccc gcc acc tcg gag atc ttc aac caa tta ttg ggc agt 589
 His Pro Ala Thr Ser Glu Ile Phe Asn Gln Leu Leu Gly Ser
 150 155 160
 taacgcagcg gatcgaacgg ctt 612

 <210> 198
 <211> 163
 <212> PRT
 <213> Corynebacterium glutamicum

 <400> 198
 Val Leu Val Asp Ala His Leu Arg Thr Asn Ile Asp Gly Ile Phe Ala
 1 5 10 15
 Val Gly Asp Val Asn Gly Gly Pro Gln Phe Thr Tyr Val Ser Tyr Asp
 20 25 30
 Asp His Arg Ile Val Leu Asp Gln Leu Ala Gly Thr Gly Lys Lys Ser
 35 40 45
 Ile Ala His Arg Leu Ile Pro Thr Thr Thr Phe Ile Glu Pro Pro Leu
 50 55 60
 Ser Thr Ile Gly Asp Asn Thr Glu Gly Glu Asn Val Val Val Lys Lys
 65 70 75 80
 Ala Leu Ile Ala Asp Met Pro Ile Val Pro Arg Pro Glu Ile Ile Asn
 85 90 95
 Gln Pro His Gly Met Val Lys Phe Phe Val Asp Lys Gln Ser Asp Ala
 100 105 110

Leu Leu Gly Ala Thr Leu Tyr Cys Ala Asp Ser Gln Glu Leu Ile Asn
 115 120 125

Thr Val Ala Leu Ala Met Arg His Gly Val Thr Ala Ser Glu Leu Gly
 130 135 140

Asp Gly Ile Tyr Thr His Pro Ala Thr Ser Glu Ile Phe Asn Gln Leu
 145 150 155 160

Leu Gly Ser

<210> 199

<211> 561

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(538)

<223> RXN03123

<400> 199

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tggcttttgt gctgcacgag ccgctggggc ccgcctcggc gtg ggc gac gcg ctg 115
 Val Gly Asp Ala Leu
 1 5

cga ggc cgg gga aag cct gaa gtc atg cgc tac cca gga att ccg ttc 163
 Arg Gly Arg Gly Lys Pro Glu Val Met Arg Tyr Pro Gly Ile Pro Phe
 10 15 20

gcc atc cca gat cca gcg ccg cgt ggc ttc ctt ttc tta ggc gat ctc 211
 Ala Ile Pro Asp Pro Ala Pro Arg Gly Phe Leu Phe Leu Gly Asp Leu
 25 30 35

acc tct tac cca gcg atc tgc tcg att ctg gag acc ttg gac ggt gaa 259
 Thr Ser Tyr Pro Ala Ile Cys Ser Ile Leu Glu Thr Leu Asp Gly Glu
 40 45 50

atc cct gcg acc gcg tat ctt atc gcc cac gat cca ctt gat tac acc 307
 Ile Pro Ala Thr Ala Tyr Leu Ile Ala His Asp Pro Leu Asp Tyr Thr
 55 60 65

ttc gat ttt ccc cag ggc gag cac atc acc gcg cag tgg att tcc aac 355
 Phe Asp Phe Pro Gln Gly Glu His Ile Thr Ala Gln Trp Ile Ser Asn
 70 75 80 85

gaa caa tcc ttc att gat cac atc gct gac acg gat tac acc gat ttt 403
 Glu Gln Ser Phe Ile Asp His Ile Ala Asp Thr Asp Tyr Thr Asp Phe
 90 95 100

tat acc tgg atc ggc gcg gaa tcc tcc gaa acc cgt gcg gcc aag aag 451
 Tyr Thr Trp Ile Gly Ala Glu Ser Ser Glu Thr Arg Ala Ala Lys Lys
 105 110 115

cat ctg cag acc cac gcc ggc atg ccc aag acg cac atg aac gcg caa 499
 His Leu Gln Thr His Ala Gly Met Pro Lys Thr His Met Asn Ala Gln
 120 125 130

ggt tat tgg aac aag ggc aga gcc atg ggt aaa agc aat taaaagattt 548
 Gly Tyr Trp Asn Lys Gly Arg Ala Met Gly Lys Ser Asn
 135 140 145

ttgcttatcg acg 561

<210> 200
 <211> 146
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 200
 Val Gly Asp Ala Leu Arg Gly Arg Gly Lys Pro Glu Val Met Arg Tyr
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 Pro Gly Ile Pro Phe Ala Ile Pro Asp Pro Ala Pro Arg Gly Phe Leu
 20 25 30
 Phe Leu Gly Asp Leu Thr Ser Tyr Pro Ala Ile Cys Ser Ile Leu Glu
 35 40 45
 Thr Leu Asp Gly Glu Ile Pro Ala Thr Ala Tyr Leu Ile Ala His Asp
 50 55 60
 Pro Leu Asp Tyr Thr Phe Asp Phe Pro Gln Gly Glu His Ile Thr Ala
 65 70 75 80
 Gln Trp Ile Ser Asn Glu Gln Ser Phe Ile Asp His Ile Ala Asp Thr
 85 90 95
 Asp Tyr Thr Asp Phe Tyr Thr Trp Ile Gly Ala Glu Ser Ser Glu Thr
 100 105 110
 Arg Ala Ala Lys Lys His Leu Gln Thr His Ala Gly Met Pro Lys Thr
 115 120 125
 His Met Asn Ala Gln Gly Tyr Trp Asn Lys Gly Arg Ala Met Gly Lys
 130 135 140
 Ser Asn
 145

<210> 201
 <211> 736
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(736)

<400> 201

261

acc gat ttt tat acc tgg atc ggc gcg gaa tcc tcc gaa acc cgt
 Thr Asp Phe Tyr Thr Trp Ile Gly Ala Glu Ser Ser Glu Thr Arg
 200 205 210

736

<210> 202
 <211> 212
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 202
 Met Gly Lys Gly Phe Thr Gly Ala Ile Leu Thr Val Met Gly Val Lys
 1 5 10 15

Ser His Ile Ala Thr Thr Thr Gly Lys Thr Val Ile Asn Asp Arg Met
 20 25 30

Val Thr Ile His Phe His Ser Glu Thr Leu Leu Asn Thr Glu Gly Glu
 35 40 45

Val Pro Gly Asp Trp Leu Arg Leu Trp Phe Pro His Glu Ser Arg Pro
 50 55 60

Gly Lys Leu Tyr Gln Arg Ala Tyr Thr Leu Thr Asn Val Asp Ala Asp
 65 70 75 80

Ala Gly Thr Phe Asp Leu Ala Phe Val Leu His Glu Pro Leu Gly Pro
 85 90 95

Ala Ser Ala Trp Ala Thr Arg Cys Glu Ala Gly Glu Ser Leu Glu Val
 100 105 110

Met Arg Tyr Pro Gly Ile Pro Phe Ala Ile Pro Asp Pro Ala Pro Arg
 115 120 125

Gly Phe Leu Phe Leu Gly Asp Leu Thr Ser Tyr Pro Ala Ile Cys Ser
 130 135 140

Ile Leu Glu Thr Leu Asp Gly Glu Ile Pro Ala Thr Ala Tyr Leu Ile
 145 150 155 160

Ala His Asp Pro Leu Asp Tyr Thr Phe Asp Phe Pro Gln Gly Glu His
 165 170 175

Ile Thr Ala Gln Trp Ile Ser Asn Glu Gln Ser Phe Ile Asp His Ile
 180 185 190

Ala Asp Thr Asp Tyr Thr Asp Phe Tyr Thr Trp Ile Gly Ala Glu Ser
 195 200 205

Ser Glu Thr Arg
 210

<210> 203
 <211> 732
 <212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(709)

<223> RXA01051

<400> 203

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taacagtgaa cacacaggcc atccccctag ggttggccat atg tca acc att cac    115
                                   Met Ser Thr Ile His
                                   1                               5

gcc tcc gga atc cag gct cca caa gtg cca cac ggt tcc cac cat gcc    163
Ala Ser Gly Ile Gln Ala Pro Gln Val Pro His Gly Ser His His Ala
                        10                               15                               20

ccg cca caa aag gac gaa tca gtg aag aag agc ttc aat gcc tct tct    211
Pro Pro Gln Lys Asp Glu Ser Val Lys Lys Ser Phe Asn Ala Ser Ser
                        25                               30                               35

tta ctg ttc gcg ttt tcc ttc ggc gtg tac ctg gtg ctg ctt gtg atg    259
Leu Leu Phe Ala Phe Ser Phe Gly Val Tyr Leu Val Leu Leu Val Met
                        40                               45                               50

atg aca ctt ctt aaa agt cgc ctt tct tta ggc gga ctg tgg aac aca    307
Met Thr Leu Leu Lys Ser Arg Leu Ser Leu Gly Gly Leu Trp Asn Thr
                        55                               60                               65

gaa gca cac caa tac aga tcc atc gac tta gag ctt ttc aac ggc ttt    355
Glu Ala His Gln Tyr Arg Ser Ile Asp Leu Glu Leu Phe Asn Gly Phe
                        70                               75                               80                               85

gct gat cca cca att tgg tgg ggg cct tgg acc aac act ttt ggc aac    403
Ala Asp Pro Pro Ile Trp Trp Gly Pro Trp Thr Asn Thr Phe Gly Asn
                        90                               95                               100

atc gca ctg ttc atg cca ttt ggg ttt ttc ctg tac aaa atg ctc cgt    451
Ile Ala Leu Phe Met Pro Phe Gly Phe Phe Leu Tyr Lys Met Leu Arg
                        105                               110                               115

aga ttc aac cat cga ttc ccc ttc gta gaa acc atc ctg ttt gcc agc    499
Arg Phe Asn His Arg Phe Pro Phe Val Glu Thr Ile Leu Phe Ala Ser
                        120                               125                               130

gtc acc agc ctc agt atc gaa gtt ctg caa tgg gtg ttt gct att gga    547
Val Thr Ser Leu Ser Ile Glu Val Leu Gln Trp Val Phe Ala Ile Gly
                        135                               140                               145

tat tca gat gtc gat gac ctg ttg ttt aat acg atc ggc gga ctc att    595
Tyr Ser Asp Val Asp Asp Leu Leu Phe Asn Thr Ile Gly Gly Leu Ile
                        150                               155                               160                               165

gga gca tcc gta gca gcg ctt gtc tcg ctt aaa tcc tcc aag gta gtc    643
Gly Ala Ser Val Ala Ala Leu Val Ser Leu Lys Ser Ser Lys Val Val
                        170                               175                               180

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agc gga atc atc atg ggc ggt tca cta tct gtg atg gcg atg atg atg 691
 Ser Gly Ile Ile Met Gly Gly Ser Leu Ser Val Met Ala Met Met Met
 185 190 195

tat tca agt ttt atc gcc tagaaggttt cagcagttcc gct 732
 Tyr Ser Ser Phe Ile Ala
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<210> 204

<211> 203

<212> PRT

<213> Corynebacterium glutamicum

<400> 204

Met Ser Thr Ile His Ala Ser Gly Ile Gln Ala Pro Gln Val Pro His
 1 5 10 15

Gly Ser His His Ala Pro Pro Gln Lys Asp Glu Ser Val Lys Lys Ser
 20 25 30

Phe Asn Ala Ser Ser Leu Leu Phe Ala Phe Ser Phe Gly Val Tyr Leu
 35 40 45

Val Leu Leu Val Met Met Thr Leu Leu Lys Ser Arg Leu Ser Leu Gly
 50 55 60

Gly Leu Trp Asn Thr Glu Ala His Gln Tyr Arg Ser Ile Asp Leu Glu
 65 70 75 80

Leu Phe Asn Gly Phe Ala Asp Pro Pro Ile Trp Trp Gly Pro Trp Thr
 85 90 95

Asn Thr Phe Gly Asn Ile Ala Leu Phe Met Pro Phe Gly Phe Phe Leu
 100 105 110

Tyr Lys Met Leu Arg Arg Phe Asn His Arg Phe Pro Phe Val Glu Thr
 115 120 125

Ile Leu Phe Ala Ser Val Thr Ser Leu Ser Ile Glu Val Leu Gln Trp
 130 135 140

Val Phe Ala Ile Gly Tyr Ser Asp Val Asp Asp Leu Leu Phe Asn Thr
 145 150 155 160

Ile Gly Gly Leu Ile Gly Ala Ser Val Ala Ala Leu Val Ser Leu Lys
 165 170 175

Ser Ser Lys Val Val Ser Gly Ile Ile Met Gly Gly Ser Leu Ser Val
 180 185 190

Met Ala Met Met Met Tyr Ser Ser Phe Ile Ala
 195 200

<210> 205

<211> 1359
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 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1336)
 <223> RXN01873

<400> 205

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acattttact aatatttgct gttggcgcat gatgaactcc atg agc caa gca ata 115
                                     Met Ser Gln Ala Ile
                                     1                               5

gat agc aag gtc gag gca cac gaa ggc cac gaa ggc cac gaa ggc atc 163
Asp Ser Lys Val Glu Ala His Glu Gly His Glu Gly His Glu Gly Ile
                10                15                20

gag cga gga aca cgc aat tac aag cgc gct gtg ttt gcg atg ctg gcc 211
Glu Arg Gly Thr Arg Asn Tyr Lys Arg Ala Val Phe Ala Met Leu Ala
                25                30                35

gcc ggt ctt gct gct ttc aat ggt ctt tat tgc acg cag gca ttg ctt 259
Ala Gly Leu Ala Ala Phe Asn Gly Leu Tyr Cys Thr Gln Ala Leu Leu
                40                45                50

ccc acc atg acg gaa gag ttg gga att acg ccc act gag tcc gcg ctg 307
Pro Thr Met Thr Glu Glu Leu Gly Ile Thr Pro Thr Glu Ser Ala Leu
                55                60                65

acg gtg tcg gct acg act gga atg ttg gcg ctg tgt att gtt ccg gcg 355
Thr Val Ser Ala Thr Thr Gly Met Leu Ala Leu Cys Ile Val Pro Ala
                70                75                80                85

tcg ata ctt tcg gag aaa ttt ggt cgc ggt cgg gtg ctg aca att tca 403
Ser Ile Leu Ser Glu Lys Phe Gly Arg Gly Arg Val Leu Thr Ile Ser
                90                95                100

ctc acg ttg gcc atc atc gtg gga tta att ttg ccg ctt gtc ccc aat 451
Leu Thr Leu Ala Ile Ile Val Gly Leu Ile Leu Pro Leu Val Pro Asn
                105                110                115

att act gct ctc atc ctg ctc aga ggt ctc caa ggt gcg ctg ctt gct 499
Ile Thr Ala Leu Ile Leu Leu Arg Gly Leu Gln Gly Ala Leu Leu Ala
                120                125                130

ggc act cca gcg gtg gcg atg acc tgg ttg tct gag gaa att cac ccc 547
Gly Thr Pro Ala Val Ala Met Thr Trp Leu Ser Glu Glu Ile His Pro
                135                140                145

aag gat att ggg cat gcg atg gga att tac atc gcg gga aat act gtc 595
Lys Asp Ile Gly His Ala Met Gly Ile Tyr Ile Ala Gly Asn Thr Val
                150                155                160                165

ggc ggg ctc act gga cgt atg att ccg gcg gga cta ctt gaa gta act 643

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| | | |
|---|---|-----|
| Gly Gly Leu Thr | Gly Arg Met Ile Pro Ala Gly Leu Leu Glu Val Thr | |
| 170 | 175 | 180 |
| cat tgg caa aac gca ctg ctg gga agt tct atc gct gcg ctg atc ttc | 691 | |
| His Trp Gln Asn Ala Leu Leu Gly Ser Ser Ile Ala Ala Leu Ile Phe | | |
| 185 | 190 | 195 |
| ggc gta atc atg gtg gtg ttg ctt ccc aag cag cgg aaa ttc cag ccg | 739 | |
| Gly Val Ile Met Val Val Leu Leu Pro Lys Gln Arg Lys Phe Gln Pro | | |
| 200 | 205 | 210 |
| aag aat atc aat ctg cgc cat gag att tcg gcg atg gct gct cat tgg | 787 | |
| Lys Asn Ile Asn Leu Arg His Glu Ile Ser Ala Met Ala Ala His Trp | | |
| 215 | 220 | 225 |
| cgg aat cct cgt ttg gcg ttg ctt ttt ggt act gcg ttt ttg ggc atg | 835 | |
| Arg Asn Pro Arg Leu Ala Leu Leu Phe Gly Thr Ala Phe Leu Gly Met | | |
| 230 | 235 | 240 |
| ggc act ttt gtg tcg ctg tac aac tat ttg ggt ttc cgc atg att gat | 883 | |
| Gly Thr Phe Val Ser Leu Tyr Asn Tyr Leu Gly Phe Arg Met Ile Asp | | |
| 250 | 255 | 260 |
| cag ttt ggg ctg agt gaa gtg ctg gtt ggt gcg gtg ttc atc atg tat | 931 | |
| Gln Phe Gly Leu Ser Glu Val Leu Val Gly Ala Val Phe Ile Met Tyr | | |
| 265 | 270 | 275 |
| ctg gcc ggg acc tgg agt tcc acc cag gcg ggt gcg ttg agg gag aag | 979 | |
| Leu Ala Gly Thr Trp Ser Ser Thr Gln Ala Gly Ala Leu Arg Glu Lys | | |
| 280 | 285 | 290 |
| atc ggc aat ggg tca acg gtt att ttc ttg agt ctg acg atg atc gcg | 1027 | |
| Ile Gly Asn Gly Ser Thr Val Ile Phe Leu Ser Leu Thr Met Ile Ala | | |
| 295 | 300 | 305 |
| tcg atg gca ctg atg ggg att aat aat ttg tgg gtc acg ttg gtt gcc | 1075 | |
| Ser Met Ala Leu Met Gly Ile Asn Asn Leu Trp Val Thr Leu Val Ala | | |
| 310 | 315 | 320 |
| ctg ttt gtg ttt acc gcg gca ttt ttc gca ctg cat tcc agt gct tcg | 1123 | |
| Leu Phe Val Phe Thr Ala Ala Phe Phe Ala Leu His Ser Ser Ala Ser | | |
| 330 | 335 | 340 |
| gga tgg atc gga atc atc gca acg aag gat cgc gcg gaa gcc tcc agc | 1171 | |
| Gly Trp Ile Gly Ile Ile Ala Thr Lys Asp Arg Ala Glu Ala Ser Ser | | |
| 345 | 350 | 355 |
| atg tat ttg ttc tgt tat tac gtg gga tcc tcg gtg att ggt tgg gtt | 1219 | |
| Met Tyr Leu Phe Cys Tyr Tyr Val Gly Ser Ser Val Ile Gly Trp Val | | |
| 360 | 365 | 370 |
| tct gga ttc gcg ttt acg cat ttg ccg tgg ttg gcg ttc att ggc tgg | 1267 | |
| Ser Gly Phe Ala Phe Thr His Leu Pro Trp Leu Ala Phe Ile Gly Trp | | |
| 375 | 380 | 385 |
| ttg att ctg ctt ctt tgc gga gtg ctg gcg att tgt gtg acg ctg gca | 1315 | |
| Leu Ile Leu Leu Leu Cys Gly Val Leu Ala Ile Cys Val Thr Leu Ala | | |

390

395

400

405

agg ctt gcc cgc aac gcc aat taatacgagt ttgtccgtgt tta
 Arg Leu Ala Arg Asn Ala Asn
 410

1359

<210> 206

<211> 412

<212> PRT

<213> Corynebacterium glutamicum

<400> 206

Met Ser Gln Ala Ile Asp Ser Lys Val Glu Ala His Glu Gly His Glu
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Gly His Glu Gly Ile Glu Arg Gly Thr Arg Asn Tyr Lys Arg Ala Val
 20 25 30

Phe Ala Met Leu Ala Ala Gly Leu Ala Ala Phe Asn Gly Leu Tyr Cys
 35 40 45

Thr Gln Ala Leu Leu Pro Thr Met Thr Glu Glu Leu Gly Ile Thr Pro
 50 55 60

Thr Glu Ser Ala Leu Thr Val Ser Ala Thr Thr Gly Met Leu Ala Leu
 65 70 75 80

Cys Ile Val Pro Ala Ser Ile Leu Ser Glu Lys Phe Gly Arg Gly Arg
 85 90 95

Val Leu Thr Ile Ser Leu Thr Leu Ala Ile Ile Val Gly Leu Ile Leu
 100 105 110

Pro Leu Val Pro Asn Ile Thr Ala Leu Ile Leu Leu Arg Gly Leu Gln
 115 120 125

Gly Ala Leu Leu Ala Gly Thr Pro Ala Val Ala Met Thr Trp Leu Ser
 130 135 140

Glu Glu Ile His Pro Lys Asp Ile Gly His Ala Met Gly Ile Tyr Ile
 145 150 155 160

Ala Gly Asn Thr Val Gly Gly Leu Thr Gly Arg Met Ile Pro Ala Gly
 165 170 175

Leu Leu Glu Val Thr His Trp Gln Asn Ala Leu Leu Gly Ser Ser Ile
 180 185 190

Ala Ala Leu Ile Phe Gly Val Ile Met Val Val Leu Leu Pro Lys Gln
 195 200 205

Arg Lys Phe Gln Pro Lys Asn Ile Asn Leu Arg His Glu Ile Ser Ala
 210 215 220

Met Ala Ala His Trp Arg Asn Pro Arg Leu Ala Leu Leu Phe Gly Thr
 225 230 235 240

Ala Phe Leu Gly Met Gly Thr Phe Val Ser Leu Tyr Asn Tyr Leu Gly
 245 250 255

Phe Arg Met Ile Asp Gln Phe Gly Leu Ser Glu Val Leu Val Gly Ala
 260 265 270

Val Phe Ile Met Tyr Leu Ala Gly Thr Trp Ser Ser Thr Gln Ala Gly
 275 280 285

Ala Leu Arg Glu Lys Ile Gly Asn Gly Ser Thr Val Ile Phe Leu Ser
 290 295 300

Leu Thr Met Ile Ala Ser Met Ala Leu Met Gly Ile Asn Asn Leu Trp
 305 310 315 320

Val Thr Leu Val Ala Leu Phe Val Phe Thr Ala Ala Phe Phe Ala Leu
 325 330 335

His Ser Ser Ala Ser Gly Trp Ile Gly Ile Ile Ala Thr Lys Asp Arg
 340 345 350

Ala Glu Ala Ser Ser Met Tyr Leu Phe Cys Tyr Tyr Val Gly Ser Ser
 355 360 365

Val Ile Gly Trp Val Ser Gly Phe Ala Phe Thr His Leu Pro Trp Leu
 370 375 380

Ala Phe Ile Gly Trp Leu Ile Leu Leu Leu Cys Gly Val Leu Ala Ile
 385 390 395 400

Cys Val Thr Leu Ala Arg Leu Ala Arg Asn Ala Asn
 405 410

<210> 207
 <211> 1215
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1192)
 <223> FRXA01873

<400> 207
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 acattttact aatatttgct gttggcgcat gatgaactcc atg agc caa gca ata 115
 Met Ser Gln Ala Ile
 1 5
 gat agc aag gtc gag gca cac gaa ggc cac gaa ggc cac gaa ggc atc 163
 Asp Ser Lys Val Glu Ala His Glu Gly His Glu Gly His Glu Gly Ile
 10 15 20
 gag cga gga aca cgc aat tac aag cgc gct gtg ttt gcg atg ctg gcc 211

| | |
|---|-----|
| Glu Arg Gly Thr Arg Asn Tyr Lys Arg Ala Val Phe Ala Met Leu Ala | |
| 25 30 35 | |
| gcc ggt ctt gct gct ttc aat ggt ctt tat tgc acg cag gca ttg ctt | 259 |
| Ala Gly Leu Ala Ala Phe Asn Gly Leu Tyr Cys Thr Gln Ala Leu Leu | |
| 40 45 50 | |
| ccc acc atg acg gaa gag ttg gga att acg ccc act gag tcc gcg ctg | 307 |
| Pro Thr Met Thr Glu Glu Leu Gly Ile Thr Pro Thr Glu Ser Ala Leu | |
| 55 60 65 | |
| acg gtg tcg gct acg act gga atg ttg gcg ctg tgt att gtt ccg gcg | 355 |
| Thr Val Ser Ala Thr Thr Gly Met Leu Ala Leu Cys Ile Val Pro Ala | |
| 70 75 80 85 | |
| tcg ata ctt tcg gag aaa ttt ggt cgc ggt cgg gtg ctg aca att tca | 403 |
| Ser Ile Leu Ser Glu Lys Phe Gly Arg Gly Arg Val Leu Thr Ile Ser | |
| 90 95 100 | |
| ctc acg ttg gcc atc atc gtg gga tta att ttg ccg ctt gtc ccc aat | 451 |
| Leu Thr Leu Ala Ile Ile Val Gly Leu Ile Leu Pro Leu Val Pro Asn | |
| 105 110 115 | |
| att act gct ctc atc ctg ctc aga ggt ctc caa ggt gcg ctg ctt gct | 499 |
| Ile Thr Ala Leu Ile Leu Leu Arg Gly Leu Gln Gly Ala Leu Leu Ala | |
| 120 125 130 | |
| ggc act cca gcg gtg gcg atg acc tgg ttg tct gag gaa att cac ccc | 547 |
| Gly Thr Pro Ala Val Ala Met Thr Trp Leu Ser Glu Glu Ile His Pro | |
| 135 140 145 | |
| aag gat att ggg cat gcg atg gga att tac atc gcg gga aat act gtc | 595 |
| Lys Asp Ile Gly His Ala Met Gly Ile Tyr Ile Ala Gly Asn Thr Val | |
| 150 155 160 165 | |
| ggc ggg ctc act gga cgt atg att ccg gcg gga cta ctt gaa gta act | 643 |
| Gly Gly Leu Thr Gly Arg Met Ile Pro Ala Gly Leu Leu Glu Val Thr | |
| 170 175 180 | |
| cat tgg caa aac gca ctg ctg gga agt tct atc gct gcg ctg atc ttc | 691 |
| His Trp Gln Asn Ala Leu Leu Gly Ser Ser Ile Ala Ala Leu Ile Phe | |
| 185 190 195 | |
| ggc gta atc atg gtg gtg ttg ctt ccc aag cag cgg aaa ttc cag ccg | 739 |
| Gly Val Ile Met Val Val Leu Leu Pro Lys Gln Arg Lys Phe Gln Pro | |
| 200 205 210 | |
| aag aat atc aat ctg cgc cat gag att tcg gcg atg gct gct cat tgg | 787 |
| Lys Asn Ile Asn Leu Arg His Glu Ile Ser Ala Met Ala Ala His Trp | |
| 215 220 225 | |
| cgg aat cct cgt ttg gcg ttg ctt ttt ggt act gcg ttt ttg ggc atg | 835 |
| Arg Asn Pro Arg Leu Ala Leu Leu Phe Gly Thr Ala Phe Leu Gly Met | |
| 230 235 240 245 | |
| ggt act ttt gtg tcg ctg tac aac tat ttg ggt ttc cgc atg att gat | 883 |
| Gly Thr Phe Val Ser Leu Tyr Asn Tyr Leu Gly Phe Arg Met Ile Asp | |

| 250 | 255 | 260 | |
|---|-----|-----|------|
| cag ttt ggg ctg agt gaa gtg ctg gtt ggt gcg gtg ttc atc atg tat | | | 931 |
| Gln Phe Gly Leu Ser Glu Val Leu Val Gly Ala Val Phe Ile Met Tyr | | | |
| 265 | 270 | 275 | |
| ctg gcc ggg acc tgg agt tcc acc cag gcg ggt gcg ttg agg gag aag | | | 979 |
| Leu Ala Gly Thr Trp Ser Ser Thr Gln Ala Gly Ala Leu Arg Glu Lys | | | |
| 280 | 285 | 290 | |
| atc ggc aat ggg tca acg gtt att ttc ttg agt ctg acg atg atc gcg | | | 1027 |
| Ile Gly Asn Gly Ser Thr Val Ile Phe Leu Ser Leu Thr Met Ile Ala | | | |
| 295 | 300 | 305 | |
| tcg atg gca ctg atg ggg att aat aat ttg tgg gtc acg ttg gtt gcc | | | 1075 |
| Ser Met Ala Leu Met Gly Ile Asn Asn Leu Trp Val Thr Leu Val Ala | | | |
| 310 | 315 | 320 | 325 |
| ctg ttt gtg ttt acc gcg gca ttt ttc gca ctg cat tcc agt gct tcg | | | 1123 |
| Leu Phe Val Phe Thr Ala Ala Phe Phe Ala Leu His Ser Ser Ala Ser | | | |
| 330 | 335 | 340 | |
| gga tgg atc gga atc atc gca acg aag gat cgc gcg gaa gcc tcc agc | | | 1171 |
| Gly Trp Ile Gly Ile Ile Ala Thr Lys Asp Arg Ala Glu Ala Ser Ser | | | |
| 345 | 350 | 355 | |
| atg tat ttg ttc tgt gaa tac taggatcctc ggtgattggt tgg | | | 1215 |
| Met Tyr Leu Phe Cys Glu Tyr | | | |
| 360 | | | |

<210> 208

<211> 364

<212> PRT

<213> Corynebacterium glutamicum

<400> 208

| | | | |
|---|-----|-----|----|
| Met Ser Gln Ala Ile Asp Ser Lys Val Glu Ala His Glu Gly His Glu | | | |
| 1 | 5 | 10 | 15 |
| Gly His Glu Gly Ile Glu Arg Gly Thr Arg Asn Tyr Lys Arg Ala Val | | | |
| 20 | 25 | 30 | |
| Phe Ala Met Leu Ala Ala Gly Leu Ala Ala Phe Asn Gly Leu Tyr Cys | | | |
| 35 | 40 | 45 | |
| Thr Gln Ala Leu Leu Pro Thr Met Thr Glu Glu Leu Gly Ile Thr Pro | | | |
| 50 | 55 | 60 | |
| Thr Glu Ser Ala Leu Thr Val Ser Ala Thr Thr Gly Met Leu Ala Leu | | | |
| 65 | 70 | 75 | 80 |
| Cys Ile Val Pro Ala Ser Ile Leu Ser Glu Lys Phe Gly Arg Gly Arg | | | |
| 85 | 90 | 95 | |
| Val Leu Thr Ile Ser Leu Thr Leu Ala Ile Ile Val Gly Leu Ile Leu | | | |
| 100 | 105 | 110 | |

Pro Leu Val Pro Asn Ile Thr Ala Leu Ile Leu Leu Arg Gly Leu Gln
 115 120 125
 Gly Ala Leu Leu Ala Gly Thr Pro Ala Val Ala Met Thr Trp Leu Ser
 130 135 140
 Glu Glu Ile His Pro Lys Asp Ile Gly His Ala Met Gly Ile Tyr Ile
 145 150 155 160
 Ala Gly Asn Thr Val Gly Gly Leu Thr Gly Arg Met Ile Pro Ala Gly
 165 170 175
 Leu Leu Glu Val Thr His Trp Gln Asn Ala Leu Leu Gly Ser Ser Ile
 180 185 190
 Ala Ala Leu Ile Phe Gly Val Ile Met Val Val Leu Leu Pro Lys Gln
 195 200 205
 Arg Lys Phe Gln Pro Lys Asn Ile Asn Leu Arg His Glu Ile Ser Ala
 210 215 220
 Met Ala Ala His Trp Arg Asn Pro Arg Leu Ala Leu Leu Phe Gly Thr
 225 230 235 240
 Ala Phe Leu Gly Met Gly Thr Phe Val Ser Leu Tyr Asn Tyr Leu Gly
 245 250 255
 Phe Arg Met Ile Asp Gln Phe Gly Leu Ser Glu Val Leu Val Gly Ala
 260 265 270
 Val Phe Ile Met Tyr Leu Ala Gly Thr Trp Ser Ser Thr Gln Ala Gly
 275 280 285
 Ala Leu Arg Glu Lys Ile Gly Asn Gly Ser Thr Val Ile Phe Leu Ser
 290 295 300
 Leu Thr Met Ile Ala Ser Met Ala Leu Met Gly Ile Asn Asn Leu Trp
 305 310 315 320
 Val Thr Leu Val Ala Leu Phe Val Phe Thr Ala Ala Phe Phe Ala Leu
 325 330 335
 His Ser Ser Ala Ser Gly Trp Ile Gly Ile Ile Ala Thr Lys Asp Arg
 340 345 350
 Ala Glu Ala Ser Ser Met Tyr Leu Phe Cys Glu Tyr
 355 360

<210> 209
 <211> 1572
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS

<222> (101)..(1549)

<223> RXN00034

<400> 209

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                                   Met Ser Tyr Thr Ser
                                   1                               5

ttt aaa ggc gat gat aaa gcc ctc atc ggc ata gtt tta tca gtt ctc 163
Phe Lys Gly Asp Asp Lys Ala Leu Ile Gly Ile Val Leu Ser Val Leu
                                   10                               15                               20

aca ttt tgg ctt ttt gct cag tca acc cta aat atc ggc cca gat atg 211
Thr Phe Trp Leu Phe Ala Gln Ser Thr Leu Asn Ile Gly Pro Asp Met
                                   25                               30                               35

gca act gat tta ggg atg agc gat ggc acc atg aac ata gct gtc gtg 259
Ala Thr Asp Leu Gly Met Ser Asp Gly Thr Met Asn Ile Ala Val Val
                                   40                               45                               50

gcc gcc gcg tta ttc tgt gga aca ttt atc gtc gca gcc ggc ggc atc 307
Ala Ala Ala Leu Phe Cys Gly Thr Phe Ile Val Ala Ala Gly Gly Ile
                                   55                               60                               65

gca gat gtc ttt ggc cga gta cga atc atg atg att ggc aac atc ctt 355
Ala Asp Val Phe Gly Arg Val Arg Ile Met Met Ile Gly Asn Ile Leu
                                   70                               75                               80                               85

aac atc ctg gga tct ctc ctc atc gcc acg gca acg act tct tta gcc 403
Asn Ile Leu Gly Ser Leu Leu Ile Ala Thr Ala Thr Thr Ser Leu Ala
                                   90                               95                               100

acc caa atg gtg atc acc ggc cga gtt ctc caa gga ctg gca gca gcg 451
Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln Gly Leu Ala Ala Ala
                                   105                               110                               115

gcc atc atg tct gca tcc cta gca tta gtt aag aca tat tgg tta ggt 499
Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys Thr Tyr Trp Leu Gly
                                   120                               125                               130

act gac cgc caa cga gca gtc tcc att tgg tcc att ggt tca tgg ggt 547
Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser Ile Gly Ser Trp Gly
                                   135                               140                               145

ggc acc gga ttc tgc gcg ctt ttc gcg ggt ctt gtt gta gca agc ccc 595
Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu Val Val Ala Ser Pro
150                               155                               160                               165

ttt ggt tgg aga gga atc ttc gcc ctc tgc gcg atc gtc tcc atc gtt 643
Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala Ile Val Ser Ile Val
                                   170                               175                               180

gct att gcc ctt acc cgc cac atc ccg gaa tcc cgt ccg gct caa tcc 691
Ala Ile Ala Leu Thr Arg His Ile Pro Glu Ser Arg Pro Ala Gln Ser
                                   185                               190                               195

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| | |
|---|------|
| att ggc atg cat ttg gat tgg agt ggc atc atc gtt ctt gcc ctc agt Ile Gly Met His Leu Asp Trp Ser Gly Ile Ile Val Leu Ala Leu Ser 200 205 210 | 739 |
| gtt cta tct ctt gaa ttg ttt att acc caa ggt gaa tca ctt ggc tgg Val Leu Ser Leu Glu Leu Phe Ile Thr Gln Gly Glu Ser Leu Gly Trp 215 220 225 | 787 |
| acg cac tgg atg acc tgg act ctc ctt gcc gtt tct ttg aca ttt ctt Thr His Trp Met Thr Trp Thr Leu Leu Ala Val Ser Leu Thr Phe Leu 230 235 240 245 | 835 |
| gca gtt ttc gtc ttc att gaa cgc atc gcc agc tgg cca gtt ctc gac Ala Val Phe Val Phe Ile Glu Arg Ile Ala Ser Trp Pro Val Leu Asp 250 255 260 | 883 |
| ttc aac ctt ttc aaa gac cac gcc ttc agc ggt gcg acc atc acc aac Phe Asn Leu Phe Lys Asp His Ala Phe Ser Gly Ala Thr Ile Thr Asn 265 270 275 | 931 |
| ttc att atg agc gct act ggc gga gta gtt gcc gtt gtc atg tgg gtt Phe Ile Met Ser Ala Thr Gly Gly Val Val Ala Val Val Met Trp Val 280 285 290 | 979 |
| cag caa atg gga tgg ggt gtc tcc cca aca atc tcg gga ctc acc agc Gln Gln Met Gly Trp Gly Val Ser Pro Thr Ile Ser Gly Leu Thr Ser 295 300 305 | 1027 |
| atc ggc ttc gca gcc ttt gtc atc ctt ttc att cga gtt gga gaa aag Ile Gly Phe Ala Ala Phe Val Ile Leu Phe Ile Arg Val Gly Glu Lys 310 315 320 325 | 1075 |
| gcc atg cag aaa gtt ggc gcc cga gca gtg atc atc acc gct ggc atc Ala Met Gln Lys Val Gly Ala Arg Ala Val Ile Ile Thr Ala Gly Ile 330 335 340 | 1123 |
| ttg gta gcg acc gcg acc gcc ctc cta atg atc acc gcg gtc agc gag Leu Val Ala Thr Ala Thr Ala Leu Leu Met Ile Thr Ala Val Ser Glu 345 350 355 | 1171 |
| tca acg tac atc gtc atc tcc ctc gcc ggc ttc tcc ctt tat ggc ctt Ser Thr Tyr Ile Val Ile Ser Leu Ala Gly Phe Ser Leu Tyr Gly Leu 360 365 370 | 1219 |
| ggc ctc gga ctc ttc gcc acc cca gtc acc gat act gcg ctt gga aca Gly Leu Gly Leu Phe Ala Thr Pro Val Thr Asp Thr Ala Leu Gly Thr 375 380 385 | 1267 |
| ctt ccc aaa gac cgt acc ggc gct ggt gca ggt gta ttc aag atg tcc Leu Pro Lys Asp Arg Thr Gly Ala Gly Ala Gly Val Phe Lys Met Ser 390 395 400 405 | 1315 |
| tct tcc ctc ggc gca gca ctc ggc atc gca atc tcc act tca gtg ttc Ser Ser Leu Gly Ala Ala Leu Gly Ile Ala Ile Ser Thr Ser Val Phe 410 415 420 | 1363 |

ctc gca ctt cgc gac ggc acc tcc atc aac tcc gac gtc gca ctc gcc 1411
 Leu Ala Leu Arg Asp Gly Thr Ser Ile Asn Ser Asp Val Ala Leu Ala
 425 430 435

gga aca gtt tca ctt ggc atc aac gtt gta ttc gca gca aca gcc acc 1459
 Gly Thr Val Ser Leu Gly Ile Asn Val Val Phe Ala Ala Thr Ala Thr
 440 445 450

atc acc gca gca gtc ctt att cca aaa gcc gct ggc aaa gtc tca caa 1507
 Ile Thr Ala Ala Val Leu Ile Pro Lys Ala Ala Gly Lys Val Ser Gln
 455 460 465

acc agc atc acc ctt cct gag cca gct atc gct gta aaa atc 1549
 Thr Ser Ile Thr Leu Pro Glu Pro Ala Ile Ala Val Lys Ile
 470 475 480

taaaacttca ccaggacaga taa 1572

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 <213> Corynebacterium glutamicum

<400> 210
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Val Leu Ser Val Leu Thr Phe Trp Leu Phe Ala Gln Ser Thr Leu Asn
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Ile Gly Pro Asp Met Ala Thr Asp Leu Gly Met Ser Asp Gly Thr Met
 35 40 45

Asn Ile Ala Val Val Ala Ala Ala Leu Phe Cys Gly Thr Phe Ile Val
 50 55 60

Ala Ala Gly Gly Ile Ala Asp Val Phe Gly Arg Val Arg Ile Met Met
 65 70 75 80

Ile Gly Asn Ile Leu Asn Ile Leu Gly Ser Leu Leu Ile Ala Thr Ala
 85 90 95

Thr Thr Ser Leu Ala Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln
 100 105 110

Gly Leu Ala Ala Ala Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys
 115 120 125

Thr Tyr Trp Leu Gly Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser
 130 135 140

Ile Gly Ser Trp Gly Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu
 145 150 155 160

Val Val Ala Ser Pro Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala
 165 170 175

Ile Val Ser Ile Val Ala Ile Ala Leu Thr Arg His Ile Pro Glu Ser
 180 185 190
 Arg Pro Ala Gln Ser Ile Gly Met His Leu Asp Trp Ser Gly Ile Ile
 195 200 205
 Val Leu Ala Leu Ser Val Leu Ser Leu Glu Leu Phe Ile Thr Gln Gly
 210 215 220
 Glu Ser Leu Gly Trp Thr His Trp Met Thr Trp Thr Leu Leu Ala Val
 225 230 235 240
 Ser Leu Thr Phe Leu Ala Val Phe Val Phe Ile Glu Arg Ile Ala Ser
 245 250 255
 Trp Pro Val Leu Asp Phe Asn Leu Phe Lys Asp His Ala Phe Ser Gly
 260 265 270
 Ala Thr Ile Thr Asn Phe Ile Met Ser Ala Thr Gly Gly Val Val Ala
 275 280 285
 Val Val Met Trp Val Gln Gln Met Gly Trp Gly Val Ser Pro Thr Ile
 290 295 300
 Ser Gly Leu Thr Ser Ile Gly Phe Ala Ala Phe Val Ile Leu Phe Ile
 305 310 315 320
 Arg Val Gly Glu Lys Ala Met Gln Lys Val Gly Ala Arg Ala Val Ile
 325 330 335
 Ile Thr Ala Gly Ile Leu Val Ala Thr Ala Thr Ala Leu Leu Met Ile
 340 345 350
 Thr Ala Val Ser Glu Ser Thr Tyr Ile Val Ile Ser Leu Ala Gly Phe
 355 360 365
 Ser Leu Tyr Gly Leu Gly Leu Gly Leu Phe Ala Thr Pro Val Thr Asp
 370 375 380
 Thr Ala Leu Gly Thr Leu Pro Lys Asp Arg Thr Gly Ala Gly Ala Gly
 385 390 395 400
 Val Phe Lys Met Ser Ser Ser Leu Gly Ala Ala Leu Gly Ile Ala Ile
 405 410 415
 Ser Thr Ser Val Phe Leu Ala Leu Arg Asp Gly Thr Ser Ile Asn Ser
 420 425 430
 Asp Val Ala Leu Ala Gly Thr Val Ser Leu Gly Ile Asn Val Val Phe
 435 440 445
 Ala Ala Thr Ala Thr Ile Thr Ala Ala Val Leu Ile Pro Lys Ala Ala
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 Gly Lys Val Ser Gln Thr Ser Ile Thr Leu Pro Glu Pro Ala Ile Ala
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Val Lys Ile

<210> 211

<211> 1045

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1045)

<223> FRXA02273

<400> 211

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ttttgcaagt ttctatagat tgatagaaaa gggagttag atg tct tac aca tct 115
                               Met Ser Tyr Thr Ser
                               1                               5

ttt aaa ggc gat gat aaa gcc ctc atc ggc ata gtt tta tca gtt ctc 163
Phe Lys Gly Asp Asp Lys Ala Leu Ile Gly Ile Val Leu Ser Val Leu
                               10                               15                               20

aca ttt tgg ctt ttt gct cag tca acc cta aat atc ggc cca gat atg 211
Thr Phe Trp Leu Phe Ala Gln Ser Thr Leu Asn Ile Gly Pro Asp Met
                               25                               30                               35

gca act gat tta ggg atg agc gat ggc acc atg aac ata gct gtc gtg 259
Ala Thr Asp Leu Gly Met Ser Asp Gly Thr Met Asn Ile Ala Val Val
                               40                               45                               50

gcc gcc gcg tta ttc tgt gga aca ttt atc gtc gca gcc ggc ggc atc 307
Ala Ala Ala Leu Phe Cys Gly Thr Phe Ile Val Ala Ala Gly Gly Ile
                               55                               60                               65

gca gat gtc ttt ggc cga gta cga atc atg atg att ggc aac atc ctt 355
Ala Asp Val Phe Gly Arg Val Arg Ile Met Met Ile Gly Asn Ile Leu
70                               75                               80                               85

aac atc ctg gga tct ctc ctc atc gcc acg gca acg act tct tta gcc 403
Asn Ile Leu Gly Ser Leu Leu Ile Ala Thr Ala Thr Thr Ser Leu Ala
                               90                               95                               100

acc caa atg gtg atc acc ggc cga gtt ctc caa gga ctg gca gca gcg 451
Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln Gly Leu Ala Ala Ala
                               105                               110                               115

gcc atc atg tct gca tcc cta gca tta gtt aag aca tat tgg tta ggt 499
Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys Thr Tyr Trp Leu Gly
120                               125                               130

act gac cgc caa cga gca gtc tcc att tgg tcc att ggt tca tgg ggt 547
Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser Ile Gly Ser Trp Gly
135                               140                               145

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ggc acc gga ttc tgc gcg ctt ttc gcg ggt ctt gtt gta gca agc ccc 595
 Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu Val Val Ala Ser Pro
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ttt ggt tgg aga gga atc ttc gcc ctc tgc gcg atc gtc tcc atc gtt 643
 Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala Ile Val Ser Ile Val
 170 175 180

gct att gcc ctt acc cgc cac atc ccg gaa tcc cgt ccg gct caa tcc 691
 Ala Ile Ala Leu Thr Arg His Ile Pro Glu Ser Arg Pro Ala Gln Ser
 185 190 195

att ggc atg cat ttg gat tgg agt ggc atc atc gtt ctt gcc ctc agt 739
 Ile Gly Met His Leu Asp Trp Ser Gly Ile Ile Val Leu Ala Leu Ser
 200 205 210

gtt cta tct ctt gaa ttg ttt att acc caa ggt gaa tca ctt ggc tgg 787
 Val Leu Ser Leu Glu Leu Phe Ile Thr Gln Gly Glu Ser Leu Gly Trp
 215 220 225

acg cac tgg atg acc tgg act ctc ctt gcc gtt tct ttg aca ttt ctt 835
 Thr His Trp Met Thr Trp Thr Leu Leu Ala Val Ser Leu Thr Phe Leu
 230 235 240 245

gca gtt ttc gtc ttc att gaa cgc atc gcc agc tgg cca gtt ctc gac 883
 Ala Val Phe Val Phe Ile Glu Arg Ile Ala Ser Trp Pro Val Leu Asp
 250 255 260

ttc aac ctt ttc aaa gac cac gcc ttc agc ggt gcg acc atc acc aac 931
 Phe Asn Leu Phe Lys Asp His Ala Phe Ser Gly Ala Thr Ile Thr Asn
 265 270 275

ttc att atg agc gct act ggc gga gta gtt gcc gtt gtc atg tgg gtt 979
 Phe Ile Met Ser Ala Thr Gly Gly Val Val Ala Val Val Met Trp Val
 280 285 290

cag caa atg gga tgg ggt gtc tcc cca aca atc tcg gga ctc acc agc 1027
 Gln Gln Met Gly Trp Gly Val Ser Pro Thr Ile Ser Gly Leu Thr Ser
 295 300 305

atc ggc ttc gca gcc ttt 1045
 Ile Gly Phe Ala Ala Phe
 310 315

<210> 212
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 <212> PRT
 <213> Corynebacterium glutamicum

<400> 212
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Ile Gly Pro Asp Met Ala Thr Asp Leu Gly Met Ser Asp Gly Thr Met
 35 40 45
 Asn Ile Ala Val Val Ala Ala Ala Leu Phe Cys Gly Thr Phe Ile Val
 50 55 60
 Ala Ala Gly Gly Ile Ala Asp Val Phe Gly Arg Val Arg Ile Met Met
 65 70 75 80
 Ile Gly Asn Ile Leu Asn Ile Leu Gly Ser Leu Leu Ile Ala Thr Ala
 85 90 95
 Thr Thr Ser Leu Ala Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln
 100 105 110
 Gly Leu Ala Ala Ala Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys
 115 120 125
 Thr Tyr Trp Leu Gly Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser
 130 135 140
 Ile Gly Ser Trp Gly Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu
 145 150 155 160
 Val Val Ala Ser Pro Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala
 165 170 175
 Ile Val Ser Ile Val Ala Ile Ala Leu Thr Arg His Ile Pro Glu Ser
 180 185 190
 Arg Pro Ala Gln Ser Ile Gly Met His Leu Asp Trp Ser Gly Ile Ile
 195 200 205
 Val Leu Ala Leu Ser Val Leu Ser Leu Glu Leu Phe Ile Thr Gln Gly
 210 215 220
 Glu Ser Leu Gly Trp Thr His Trp Met Thr Trp Thr Leu Leu Ala Val
 225 230 235 240
 Ser Leu Thr Phe Leu Ala Val Phe Val Phe Ile Glu Arg Ile Ala Ser
 245 250 255
 Trp Pro Val Leu Asp Phe Asn Leu Phe Lys Asp His Ala Phe Ser Gly
 260 265 270
 Ala Thr Ile Thr Asn Phe Ile Met Ser Ala Thr Gly Gly Val Val Ala
 275 280 285
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 Ser Gly Leu Thr Ser Ile Gly Phe Ala Ala Phe
 305 310 315

<210> 213

<211> 826
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(826)
 <223> RXN03075

<400> 213

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                               Val Ala Lys Phe Leu
                               1           5

tat aag tta ggc tcc acg gcc tat caa aag aaa tgg ccg ttt ctt gcg 163
Tyr Lys Leu Gly Ser Thr Ala Tyr Gln Lys Lys Trp Pro Phe Leu Ala
                10                15                20

gtc tgg ctc gtg att ctc ata ggt atc acg acg ctg gcg ggg ctg tat 211
Val Trp Leu Val Ile Leu Ile Gly Ile Thr Thr Leu Ala Gly Leu Tyr
                25                30                35

gcc aag cca acg tcg agt agc ttc tct atc cct ggt ctt gat tct gtc 259
Ala Lys Pro Thr Ser Ser Ser Phe Ser Ile Pro Gly Leu Asp Ser Val
                40                45                50

acg acc atg gag aag atg cag gag cgt ttc cct ggt tcg gat gat gca 307
Thr Thr Met Glu Lys Met Gln Glu Arg Phe Pro Gly Ser Asp Asp Ala
                55                60                65

aca tcg gct ccc act ggt tct gtc gtc att cag gca ccg gaa ggc aag 355
Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln Ala Pro Glu Gly Lys
                70                75                80                85

acc ctc act gat cct gag gtt ggg gct gaa gta aac cag atg ctt gat 403
Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val Asn Gln Met Leu Asp
                90                95                100

gag gtt cgg gcg act ggt gtg ctg aag gat gct gat tcc gtt gtg gat 451
Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala Asp Ser Val Val Asp
                105                110                115

cct gtg ttg gct gcg cag ggt gtg gct gct cag atg acc cca gcc ctg 499
Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln Met Thr Pro Ala Leu
                120                125                130

gag gct cag ggt gta cct gcg gag aag atc gcc gca gat att gag tcg 547
Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala Ala Asp Ile Glu Ser
                135                140                145

att agt cca ctg agt gca gat gag act acc ggc atc atc tcg atg act 595
Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly Ile Ile Ser Met Thr
                150                155                160                165

ttt gat gca gat tct gcc atg gat ata tcc gca gag gat cgt gag aag 643
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Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala Glu Asp Arg Glu Lys
 170 175 180

gtc acc aat att ctt gat gaa tac gat gac ggc gat ctg act gtt gtc 691
 Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly Asp Leu Thr Val Val
 185 190 195

tac aac ggc aac gtg ttt ggc gca gct gca acc agc ttg gac atg acc 739
 Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr Ser Leu Asp Met Thr
 200 205 210

tct gag ctc atc ggc ctg ctg gtg gct gcg gtc gtt ctt atc gtg acc 787
 Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val Val Leu Ile Val Thr
 215 220 225

ttc ggt tcg ttc atc gct gcc ggt atg ccg ctg atc tct 826
 Phe Gly Ser Phe Ile Ala Ala Gly Met Pro Leu Ile Ser
 230 235 240

<210> 214
 <211> 242
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 214
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Trp Pro Phe Leu Ala Val Trp Leu Val Ile Leu Ile Gly Ile Thr Thr
 20 25 30

Leu Ala Gly Leu Tyr Ala Lys Pro Thr Ser Ser Ser Phe Ser Ile Pro
 35 40 45

Gly Leu Asp Ser Val Thr Thr Met Glu Lys Met Gln Glu Arg Phe Pro
 50 55 60

Gly Ser Asp Asp Ala Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln
 65 70 75 80

Ala Pro Glu Gly Lys Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val
 85 90 95

Asn Gln Met Leu Asp Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala
 100 105 110

Asp Ser Val Val Asp Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln
 115 120 125

Met Thr Pro Ala Leu Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala
 130 135 140

Ala Asp Ile Glu Ser Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly
 145 150 155 160

Ile Ile Ser Met Thr Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala

| | | | | | |
|---|-----|--|-----|--|-----|
| | 165 | | 170 | | 175 |
| Glu Asp Arg Glu Lys Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly | | | | | |
| | 180 | | 185 | | 190 |
| Asp Leu Thr Val Val Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr | | | | | |
| | 195 | | 200 | | 205 |
| Ser Leu Asp Met Thr Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val | | | | | |
| | 210 | | 215 | | 220 |
| Val Leu Ile Val Thr Phe Gly Ser Phe Ile Ala Ala Gly Met Pro Leu | | | | | |
| | 225 | | 230 | | 235 |
| | | | | | 240 |

Ile Ser

<210> 215
 <211> 826
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(826)
 <223> FRXA02907

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 Val Ala Lys Phe Leu
 1 5
 tat aag tta ggc tcc acg gcc tat caa aag aaa tgg ccg ttt ctt gcg 163
 Tyr Lys Leu Gly Ser Thr Ala Tyr Gln Lys Lys Trp Pro Phe Leu Ala
 10 15 20
 gtc tgg ctc gtg att ctc ata ggt atc acg acg ctg gcg ggg ctg tat 211
 Val Trp Leu Val Ile Leu Ile Gly Ile Thr Thr Leu Ala Gly Leu Tyr
 25 30 35
 gcc aag cca acg tcg agt agc ttc tct atc cct ggt ctt gat tct gtc 259
 Ala Lys Pro Thr Ser Ser Ser Phe Ser Ile Pro Gly Leu Asp Ser Val
 40 45 50
 acg acc atg gag aag atg cag gag cgt ttc cct ggt tcg gat gat gca 307
 Thr Thr Met Glu Lys Met Gln Glu Arg Phe Pro Gly Ser Asp Asp Ala
 55 60 65
 aca tcg gct ccc act ggt tct gtc gtc att cag gca ccg gaa ggc aag 355
 Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln Ala Pro Glu Gly Lys
 70 75 80 85
 acc ctc act gat cct gag gtt ggg gct gaa gta aac cag atg ctt gat 403
 Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val Asn Gln Met Leu Asp

| | 90 | 95 | 100 | |
|--|---|-----|-----|-----|
| | gag gtt cgg gcg act ggt gtg ctg aag gat gct gat tcc gtt gtg gat | | | 451 |
| | Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala Asp Ser Val Val Asp | | | |
| | 105 | 110 | 115 | |
| | cct gtg ttg gct gcg cag ggt gtg gct gct cag atg acc cca gcc ctg | | | 499 |
| | Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln Met Thr Pro Ala Leu | | | |
| | 120 | 125 | 130 | |
| | gag gct cag ggt gta cct gcg gag aag atc gcc gca gat att gag tcg | | | 547 |
| | Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala Ala Asp Ile Glu Ser | | | |
| | 135 | 140 | 145 | |
| | att agt cca ctg agt gca gat gag act acc ggc atc atc tcg atg act | | | 595 |
| | Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly Ile Ile Ser Met Thr | | | |
| | 150 | 155 | 160 | 165 |
| | ttt gat gca gat tct gcc atg gat ata tcc gca gag gat cgt gag aag | | | 643 |
| | Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala Glu Asp Arg Glu Lys | | | |
| | 170 | 175 | 180 | |
| | gtc acc aat att ctt gat gaa tac gat gac ggc gat ctg act gtt gtc | | | 691 |
| | Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly Asp Leu Thr Val Val | | | |
| | 185 | 190 | 195 | |
| | tac aac ggc aac gtg ttt ggc gca gct gca acc agc ttg gac atg acc | | | 739 |
| | Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr Ser Leu Asp Met Thr | | | |
| | 200 | 205 | 210 | |
| | tct gag ctc atc ggc ctg ctg gtg gct gcg gtc gtt ctt atc gtg acc | | | 787 |
| | Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val Val Leu Ile Val Thr | | | |
| | 215 | 220 | 225 | |
| | ttc ggt tcg ttc atc gct gcc ggt atg ccg ctg atc tct | | | 826 |
| | Phe Gly Ser Phe Ile Ala Ala Gly Met Pro Leu Ile Ser | | | |
| | 230 | 235 | 240 | |

<210> 216

<211> 242

<212> PRT

<213> Corynebacterium glutamicum

<400> 216

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| Val | Ala | Lys | Phe | Leu | Tyr | Lys | Leu | Gly | Ser | Thr | Ala | Tyr | Gln | Lys | Lys |
| 1 | | | | 5 | | | | 10 | | | | | 15 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Trp | Pro | Phe | Leu | Ala | Val | Trp | Leu | Val | Ile | Leu | Ile | Gly | Ile | Thr | Thr |
| | | | 20 | | | | | 25 | | | | | 30 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Ala | Gly | Leu | Tyr | Ala | Lys | Pro | Thr | Ser | Ser | Ser | Phe | Ser | Ile | Pro |
| | | 35 | | | | 40 | | | | | | 45 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Gly | Leu | Asp | Ser | Val | Thr | Thr | Met | Glu | Lys | Met | Gln | Glu | Arg | Phe | Pro |
| | 50 | | | | | 55 | | | | | 60 | | | | |

Gly Ser Asp Asp Ala Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln
 65 70 75 80
 Ala Pro Glu Gly Lys Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val
 85 90 95
 Asn Gln Met Leu Asp Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala
 100 105 110
 Asp Ser Val Val Asp Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln
 115 120 125
 Met Thr Pro Ala Leu Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala
 130 135 140
 Ala Asp Ile Glu Ser Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly
 145 150 155 160
 Ile Ile Ser Met Thr Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala
 165 170 175
 Glu Asp Arg Glu Lys Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly
 180 185 190
 Asp Leu Thr Val Val Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr
 195 200 205
 Ser Leu Asp Met Thr Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val
 210 215 220
 Val Leu Ile Val Thr Phe Gly Ser Phe Ile Ala Ala Gly Met Pro Leu
 225 230 235 240
 Ile Ser

<210> 217
 <211> 2313
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(2290)
 <223> RXA00479

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 Met Ser Thr Ser Ile
 1 5
 aca aca gag aac aag aag aaa tct ggt cct cct cgc ttg atg aga atc 163
 Thr Thr Glu Asn Lys Lys Lys Ser Gly Pro Pro Arg Leu Met Arg Ile
 10 15 20

| | |
|---|-----|
| ttt ctg ccc gcc ttg cta att tta gtt tgg ctt gta gga gct gga gtc | 211 |
| Phe Leu Pro Ala Leu Leu Ile Leu Val Trp Leu Val Gly Ala Gly Val | |
| 25 30 35 | |
| ggc ggt cct tat ttt ggc aag gtt agt gag gtc tcc tcc aac agc cag | 259 |
| Gly Gly Pro Tyr Phe Gly Lys Val Ser Glu Val Ser Ser Asn Ser Gln | |
| 40 45 50 | |
| acc aca tat ctg cca gaa tct gcc gat gcc act caa gta cag gaa cag | 307 |
| Thr Thr Tyr Leu Pro Glu Ser Ala Asp Ala Thr Gln Val Gln Glu Gln | |
| 55 60 65 | |
| ttg gga gat ttt act gat tct gaa tcc atc cca gcc att gtc gta atg | 355 |
| Leu Gly Asp Phe Thr Asp Ser Glu Ser Ile Pro Ala Ile Val Val Met | |
| 70 75 80 85 | |
| gtc agc gat gaa ccc tta aca cag caa gac atc aca caa ctc aat gaa | 403 |
| Val Ser Asp Glu Pro Leu Thr Gln Gln Asp Ile Thr Gln Leu Asn Glu | |
| 90 95 100 | |
| gtt gtt gct ggg ctt tca gaa tta gac ata gtt tcc gat gaa gtc tcc | 451 |
| Val Val Ala Gly Leu Ser Glu Leu Asp Ile Val Ser Asp Glu Val Ser | |
| 105 110 115 | |
| cct gct att cca tcc gag gac ggc aga gct gtc caa gtg ttt gtc ccc | 499 |
| Pro Ala Ile Pro Ser Glu Asp Gly Arg Ala Val Gln Val Phe Val Pro | |
| 120 125 130 | |
| ctc aat cca tca gcg gag ctg acg gaa agc gtc gag aag ctc tct gag | 547 |
| Leu Asn Pro Ser Ala Glu Leu Thr Glu Ser Val Glu Lys Leu Ser Glu | |
| 135 140 145 | |
| acc ttg acc cag caa acg ccg gac tat gtg agc acc tat gtg acc gga | 595 |
| Thr Leu Thr Gln Gln Thr Pro Asp Tyr Val Ser Thr Tyr Val Thr Gly | |
| 150 155 160 165 | |
| ccg gct ggg ttt acc gct gat ctc agc gca gct ttc gcg ggt att gat | 643 |
| Pro Ala Gly Phe Thr Ala Asp Leu Ser Ala Ala Phe Ala Gly Ile Asp | |
| 170 175 180 | |
| ggg cta ctc cta gca gtc gcc ttg gct gcc gtc ctt gtc att ctt gtc | 691 |
| Gly Leu Leu Leu Ala Val Ala Leu Ala Val Leu Val Ile Leu Val | |
| 185 190 195 | |
| atc gtc tat cgc tcc ttc att ctg ccc atc gcc gtg ctt gcc acc agt | 739 |
| Ile Val Tyr Arg Ser Phe Ile Leu Pro Ile Ala Val Leu Ala Thr Ser | |
| 200 205 210 | |
| ttg ttt gcg ctg act gta gct cta ttg gtg gtg tgg tgg cta gct aag | 787 |
| Leu Phe Ala Leu Thr Val Ala Leu Leu Val Val Trp Trp Leu Ala Lys | |
| 215 220 225 | |
| tgg gac atc ctg ctg ctt tcg ggt cag act caa ggc atc ctc ttc att | 835 |
| Trp Asp Ile Leu Leu Ser Gly Gln Thr Gln Gly Ile Leu Phe Ile | |
| 230 235 240 245 | |

| | |
|---|------|
| ctg gtc att ggc gcc gcc acc gac tac tca ttg cta tac gtt gct cgt | 883 |
| Leu Val Ile Gly Ala Ala Thr Asp Tyr Ser Leu Leu Tyr Val Ala Arg | |
| 250 255 260 | |
| ttc cgt gaa gag tta cgc gtt caa caa gat aaa ggg ata gcc aca ggg | 931 |
| Phe Arg Glu Glu Leu Arg Val Gln Gln Asp Lys Gly Ile Ala Thr Gly | |
| 265 270 275 | |
| aaa gcc atc cgg gca tcg gtg gaa ccc att ctt gcc tcg ggc agc act | 979 |
| Lys Ala Ile Arg Ala Ser Val Glu Pro Ile Leu Ala Ser Gly Ser Thr | |
| 280 285 290 | |
| gtt att gcg ggc ctc ctt tgt ttg cta ttt agt gat ttg aaa tct aac | 1027 |
| Val Ile Ala Gly Leu Leu Cys Leu Leu Phe Ser Asp Leu Lys Ser Asn | |
| 295 300 305 | |
| tcc acg cta ggt cca gta gct tcg gtg ggc att att ttt gca atg ctt | 1075 |
| Ser Thr Leu Gly Pro Val Ala Ser Val Gly Ile Ile Phe Ala Met Leu | |
| 310 315 320 325 | |
| tct gct ctt act ctg cta cca gcc ctg ctg ttt gta ttc ggt cgg gtg | 1123 |
| Ser Ala Leu Thr Leu Leu Pro Ala Leu Leu Phe Val Phe Gly Arg Val | |
| 330 335 340 | |
| gcc ttt tgg ccc aag cga cca aaa tac gaa cct gaa aaa gcc cgt gcg | 1171 |
| Ala Phe Trp Pro Lys Arg Pro Lys Tyr Glu Pro Glu Lys Ala Arg Ala | |
| 345 350 355 | |
| aaa aac gac atc ccc gcc agc ggg atc tgg tca aaa gtg gct gat tta | 1219 |
| Lys Asn Asp Ile Pro Ala Ser Gly Ile Trp Ser Lys Val Ala Asp Leu | |
| 360 365 370 | |
| gtg gag cag cat cct cgt gca atc tgg gta tct aca ctt att gtg ctt | 1267 |
| Val Glu Gln His Pro Arg Ala Ile Trp Val Ser Thr Leu Ile Val Leu | |
| 375 380 385 | |
| ctc ttg ggt gcg gct ttc gtt ccc aca cta aaa gcg gac ggt gtg tcc | 1315 |
| Leu Leu Gly Ala Ala Phe Val Pro Thr Leu Lys Ala Asp Gly Val Ser | |
| 390 395 400 405 | |
| caa tcc gac cta gtt ctg ggt tcc tct gaa gca cgt gat ggc cag cag | 1363 |
| Gln Ser Asp Leu Val Leu Gly Ser Ser Glu Ala Arg Asp Gly Gln Gln | |
| 410 415 420 | |
| gct tta ggc gaa cac ttc ccc ggt gga tcc ggc agt cct gct tat att | 1411 |
| Ala Leu Gly Glu His Phe Pro Gly Gly Ser Gly Ser Pro Ala Tyr Ile | |
| 425 430 435 | |
| atc gtt gat gaa aca cag gca gca cag gct gct gac gta gtc ctt aac | 1459 |
| Ile Val Asp Glu Thr Gln Ala Ala Gln Ala Ala Asp Val Val Leu Asn | |
| 440 445 450 | |
| aac gac aat ttc gag act gta act gta act agt gct gac tcc ccc tct | 1507 |
| Asn Asp Asn Phe Glu Thr Val Thr Val Thr Ser Ala Asp Ser Pro Ser | |
| 455 460 465 | |
| ggc tca gcc cca atc acc gct gac ggt att gtg ccg tta ggt tct ggt | 1555 |

| | | | | | | | | | | | | | | | | |
|---|------|---------------------|-----|---------------------|------------|---------------------|-----|-----|-----|------------|-----|-----|-----|-----|------------|--|
| Gly 470 | Ser | Ala | Pro | Ile | Thr 475 | Ala | Asp | Gly | Ile | Val 480 | Pro | Leu | Gly | Ser | Gly 485 | |
| aca gct cca ggc ccg gta gtt gta gaa ggg caa gtc ctt tta caa gca | 1603 | | | | | | | | | | | | | | | |
| Thr Ala Pro Gly | 490 | Pro Val Val Val Glu | 495 | Gly Gln Val Leu | 500 | Gln Ala | | | | | | | | | | |
| aca ctt gtc gaa gca cca gat tcc gaa gaa gct caa aaa gct att cgc | 1651 | | | | | | | | | | | | | | | |
| Thr Leu Val | 505 | Glu Ala Pro Asp Ser | 510 | Glu Glu Ala Gln Lys | 515 | Ala Ile Arg | | | | | | | | | | |
| agt atc cgc caa act ttt gca gat gaa aat ata tca gcg gta gta ggc | 1699 | | | | | | | | | | | | | | | |
| Ser Ile Arg | 520 | Gln Thr Phe Ala Asp | 525 | Glu Asn Ile Ser | 530 | Ala Val Val Gly | | | | | | | | | | |
| ggt gtc act gca act tcc gta gac act aac gat gcc tcc atc cat gac | 1747 | | | | | | | | | | | | | | | |
| Gly Val Thr | 535 | Ala Thr Ser Val Asp | 540 | Thr Asn Asp | 545 | Ala Ser Ile His Asp | | | | | | | | | | |
| cgc aac ctg atc atc cca att gta ttg ctg gtc att ttg gtt att ctc | 1795 | | | | | | | | | | | | | | | |
| Arg Asn Leu Ile Ile | 550 | Pro Ile Val Leu Leu | 555 | Val Ile Leu Val | 560 | Ile Leu | 565 | | | | | | | | | |
| atg ctg ttg ctg cgg tct att gtc gca cca ctc ctg cta gta gtc acc | 1843 | | | | | | | | | | | | | | | |
| Met Leu Leu Leu Arg | 570 | Ser Ile Val Ala Pro | 575 | Leu Leu Leu Val | 580 | Val Thr | | | | | | | | | | |
| acc gtg gtg tct ttt gct act gct tta ggc gtg gct gct tta ctt ttc | 1891 | | | | | | | | | | | | | | | |
| Thr Val Val | 585 | Ser Phe Ala Thr Ala | 590 | Leu Gly Val Ala | 595 | Ala Leu Leu Phe | | | | | | | | | | |
| aat cac gtt ttc agt ttc cca gga gca gac ccc gca gta cct ctc tac | 1939 | | | | | | | | | | | | | | | |
| Asn His Val | 600 | Phe Ser Phe Pro Gly | 605 | Ala Asp Pro | 610 | Ala Val Pro Leu Tyr | | | | | | | | | | |
| gga ttt gta ttt tta gta gcc ttg ggc atc gac tac aac att ttc tta | 1987 | | | | | | | | | | | | | | | |
| Gly Phe Val | 615 | Phe Leu Val Ala Leu | 620 | Gly Ile Asp Tyr | 625 | Asn Ile Phe Leu | | | | | | | | | | |
| gtc acc cga atc cgt gaa gaa acc aaa acc cac ggc aca aga ctt gga | 2035 | | | | | | | | | | | | | | | |
| Val Thr Arg Ile Arg | 630 | Glu Glu Thr Lys Thr | 635 | His Gly Thr Arg | 640 | Leu Gly | 645 | | | | | | | | | |
| att ctt cga ggc ctg aca gta acc ggc gga gta att acc tca gct gga | 2083 | | | | | | | | | | | | | | | |
| Ile Leu Arg | 650 | Gly Leu Thr Val Thr | 655 | Gly Gly Val Ile Thr | 660 | Ser Ala Gly | | | | | | | | | | |
| gta gtt ctc gcc gca acg ttc gca gca ctc tat gtc atc cca att cta | 2131 | | | | | | | | | | | | | | | |
| Val Val Leu Ala Ala | 665 | Thr Phe Ala Ala Leu | 670 | Tyr Val Ile Pro | 675 | Ile Leu | | | | | | | | | | |
| ttc ctg gca caa att gcc ttc att gtc gct ttt gga gtt ctt att gat | 2179 | | | | | | | | | | | | | | | |
| Phe Leu Ala | 680 | Gln Ile Ala Phe Ile | 685 | Val Ala Phe Gly | 690 | Val Leu Ile Asp | | | | | | | | | | |
| acc ctg ctc gtt cgc gcc ttc ttg gtg cct gct ttg ttc tac gac atc | 2227 | | | | | | | | | | | | | | | |
| Thr Leu Leu Val | | Arg Ala Phe Leu Val | | Pro Ala Leu Phe Tyr | | Asp Ile | | | | | | | | | | |

695

700

705

gga ccg aaa atc tgg tgg ccg tca aaa ttg tcc aat cag aaa tac cag 2275
 Gly Pro Lys Ile Trp Trp Pro Ser Lys Leu Ser Asn Gln Lys Tyr Gln
 710 715 720 725

aag cag cct cag cta tgacacacca aaattcgccct ctc 2313
 Lys Gln Pro Gln Leu
 730

<210> 218

<211> 730

<212> PRT

<213> Corynebacterium glutamicum

<400> 218

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 20 25 30

Val Gly Ala Gly Val Gly Gly Pro Tyr Phe Gly Lys Val Ser Glu Val
 35 40 45

Ser Ser Asn Ser Gln Thr Thr Tyr Leu Pro Glu Ser Ala Asp Ala Thr
 50 55 60

Gln Val Gln Glu Gln Leu Gly Asp Phe Thr Asp Ser Glu Ser Ile Pro
 65 70 75 80

Ala Ile Val Val Met Val Ser Asp Glu Pro Leu Thr Gln Gln Asp Ile
 85 90 95

Thr Gln Leu Asn Glu Val Val Ala Gly Leu Ser Glu Leu Asp Ile Val
 100 105 110

Ser Asp Glu Val Ser Pro Ala Ile Pro Ser Glu Asp Gly Arg Ala Val
 115 120 125

Gln Val Phe Val Pro Leu Asn Pro Ser Ala Glu Leu Thr Glu Ser Val
 130 135 140

Glu Lys Leu Ser Glu Thr Leu Thr Gln Gln Thr Pro Asp Tyr Val Ser
 145 150 155 160

Thr Tyr Val Thr Gly Pro Ala Gly Phe Thr Ala Asp Leu Ser Ala Ala
 165 170 175

Phe Ala Gly Ile Asp Gly Leu Leu Leu Ala Val Ala Leu Ala Ala Val
 180 185 190

Leu Val Ile Leu Val Ile Val Tyr Arg Ser Phe Ile Leu Pro Ile Ala
 195 200 205

Val Leu Ala Thr Ser Leu Phe Ala Leu Thr Val Ala Leu Leu Val Val

| 210 | 215 | 220 |
|--|-----|-----|
| Trp Trp Leu Ala Lys Trp Asp Ile Leu Leu Leu Ser Gly Gln Thr Gln 225 230 235 240 | | |
| Gly Ile Leu Phe Ile Leu Val Ile Gly Ala Ala Thr Asp Tyr Ser Leu 245 250 255 | | |
| Leu Tyr Val Ala Arg Phe Arg Glu Glu Leu Arg Val Gln Gln Asp Lys 260 265 270 | | |
| Gly Ile Ala Thr Gly Lys Ala Ile Arg Ala Ser Val Glu Pro Ile Leu 275 280 285 | | |
| Ala Ser Gly Ser Thr Val Ile Ala Gly Leu Leu Cys Leu Leu Phe Ser 290 295 300 | | |
| Asp Leu Lys Ser Asn Ser Thr Leu Gly Pro Val Ala Ser Val Gly Ile 305 310 315 320 | | |
| Ile Phe Ala Met Leu Ser Ala Leu Thr Leu Leu Pro Ala Leu Leu Phe 325 330 335 | | |
| Val Phe Gly Arg Val Ala Phe Trp Pro Lys Arg Pro Lys Tyr Glu Pro 340 345 350 | | |
| Glu Lys Ala Arg Ala Lys Asn Asp Ile Pro Ala Ser Gly Ile Trp Ser 355 360 365 | | |
| Lys Val Ala Asp Leu Val Glu Gln His Pro Arg Ala Ile Trp Val Ser 370 375 380 | | |
| Thr Leu Ile Val Leu Leu Leu Gly Ala Ala Phe Val Pro Thr Leu Lys 385 390 395 400 | | |
| Ala Asp Gly Val Ser Gln Ser Asp Leu Val Leu Gly Ser Ser Glu Ala 405 410 415 | | |
| Arg Asp Gly Gln Gln Ala Leu Gly Glu His Phe Pro Gly Gly Ser Gly 420 425 430 | | |
| Ser Pro Ala Tyr Ile Ile Val Asp Glu Thr Gln Ala Ala Gln Ala Ala 435 440 445 | | |
| Asp Val Val Leu Asn Asn Asp Asn Phe Glu Thr Val Thr Val Thr Ser 450 455 460 | | |
| Ala Asp Ser Pro Ser Gly Ser Ala Pro Ile Thr Ala Asp Gly Ile Val 465 470 475 480 | | |
| Pro Leu Gly Ser Gly Thr Ala Pro Gly Pro Val Val Val Glu Gly Gln 485 490 495 | | |
| Val Leu Leu Gln Ala Thr Leu Val Glu Ala Pro Asp Ser Glu Glu Ala 500 505 510 | | |
| Gln Lys Ala Ile Arg Ser Ile Arg Gln Thr Phe Ala Asp Glu Asn Ile | | |

515 520 525
 Ser Ala Val Val Gly Gly Val Thr Ala Thr Ser Val Asp Thr Asn Asp
 530 535 540
 Ala Ser Ile His Asp Arg Asn Leu Ile Ile Pro Ile Val Leu Leu Val
 545 550 555 560
 Ile Leu Val Ile Leu Met Leu Leu Leu Arg Ser Ile Val Ala Pro Leu
 565 570 575
 Leu Leu Val Val Thr Thr Val Val Ser Phe Ala Thr Ala Leu Gly Val
 580 585 590
 Ala Ala Leu Leu Phe Asn His Val Phe Ser Phe Pro Gly Ala Asp Pro
 595 600 605
 Ala Val Pro Leu Tyr Gly Phe Val Phe Leu Val Ala Leu Gly Ile Asp
 610 615 620
 Tyr Asn Ile Phe Leu Val Thr Arg Ile Arg Glu Glu Thr Lys Thr His
 625 630 635 640
 Gly Thr Arg Leu Gly Ile Leu Arg Gly Leu Thr Val Thr Gly Gly Val
 645 650 655
 Ile Thr Ser Ala Gly Val Val Leu Ala Ala Thr Phe Ala Ala Leu Tyr
 660 665 670
 Val Ile Pro Ile Leu Phe Leu Ala Gln Ile Ala Phe Ile Val Ala Phe
 675 680 685
 Gly Val Leu Ile Asp Thr Leu Leu Val Arg Ala Phe Leu Val Pro Ala
 690 695 700
 Leu Phe Tyr Asp Ile Gly Pro Lys Ile Trp Trp Pro Ser Lys Leu Ser
 705 710 715 720
 Asn Gln Lys Tyr Gln Lys Gln Pro Gln Leu
 725 730

<210> 219
 <211> 983
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (1)..(960)
 <223> RXN03124

<400> 219
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 1 5 10 15

| | |
|---|-----|
| tac gcg cta ttt atc gtg tcc cgt ttc cgc aat gag ttg att tct cag | 96 |
| Tyr Ala Leu Phe Ile Val Ser Arg Phe Arg Asn Glu Leu Ile Ser Gln | |
| 20 25 30 | |
| act ggc gct aat gat ctg gag cca aag gaa ttg gct gag cgt ctg cgc | 144 |
| Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg | |
| 35 40 45 | |
| acc atg ccg ttg gct gct cgt gcg cat gcg atg gga atg gct gtg ggc | 192 |
| Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly | |
| 50 55 60 | |
| act gcg ggt tct gcg gtt gta ttc gcg ggt acc acg gtg ctg atc gct | 240 |
| Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala | |
| 65 70 75 80 | |
| ctg gtt gct ctg tcg atc att aat att cca ttt cta acc gtg atg gcc | 288 |
| Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala | |
| 85 90 95 | |
| att gct gcc gca atc acc gtt gcc atc gca gtt ctg gtt gct ctg tcc | 336 |
| Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser | |
| 100 105 110 | |
| ttc ctc cca gct ctg ctt ggc ctg ctt ggc act cgc atc ttc gca gca | 384 |
| Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala | |
| 115 120 125 | |
| cgc gtg cct gga cct aag gtt ccg gat cct gag gac gag aag cca acg | 432 |
| Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr | |
| 130 135 140 | |
| atg ggt ctg aag tgg gtc cgc ctt gtg cgc aag atg ccg gtg gct tac | 480 |
| Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr | |
| 145 150 155 160 | |
| ctg ctg gtt ggc gtc gtt ttg ctt ggt gca atc gca att cct gcg acc | 528 |
| Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr | |
| 165 170 175 | |
| aat atg cgc ctg gcc atg ccg act gat ggc acc tcc acg ctg ggc acc | 576 |
| Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr | |
| 180 185 190 | |
| gcg ccg cgc acg ggg tat gac atg acg gca gat gcg ttc ggc ccg ggc | 624 |
| Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly | |
| 195 200 205 | |
| cgc aac gcg ccc atg att gcg ctt atc gac gca acc gac gtc cct gag | 672 |
| Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu | |
| 210 215 220 | |
| gaa gaa cgc cca ttg gtg ttt gga cag gcg gtg gag caa ttc ttg aac | 720 |
| Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn | |
| 225 230 235 240 | |
| act gat ggt gtg aag aat gct cag atc act cag acc acg gag aat ttc | 768 |

Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu Asn Phe
 245 250 255
 gat acc gcg cag atc ctg tta ccc cag aat ttg atg cga tcg atg agc 816
 Asp Thr Ala Gln Ile Leu Leu Pro Gln Asn Leu Met Arg Ser Met Ser
 260 265 270
 gca cct ctg aga ctc tcg caa ctc ttc gtg cag atg ctg aga cct tcg 864
 Ala Pro Leu Arg Leu Ser Gln Leu Phe Val Gln Met Leu Arg Pro Ser
 275 280 285
 ctg atg aca ccg gcg cga cgt atg gca tta ctg gcg tca ccc caa ttt 912
 Leu Met Thr Pro Ala Arg Arg Met Ala Leu Leu Ala Ser Pro Gln Phe
 290 295 300
 acg atg aca tct ctg ctc gcc tcg gcg acg tcc tgg ttc ctt acg ttc 960
 Thr Met Thr Ser Leu Leu Ala Ser Ala Thr Ser Trp Phe Leu Thr Phe
 305 310 315 320
 tgatcggtttt gggttctagcg ttc 983

 <210> 220
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 <212> PRT
 <213> Corynebacterium glutamicum

 <400> 220
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 Tyr Ala Leu Phe Ile Val Ser Arg Phe Arg Asn Glu Leu Ile Ser Gln
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 Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg
 35 40 45
 Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly
 50 55 60
 Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala
 65 70 75 80
 Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala
 85 90 95
 Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser
 100 105 110
 Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala
 115 120 125
 Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr
 130 135 140
 Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr
 145 150 155 160

Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr
 165 170 175
 Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr
 180 185 190
 Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly
 195 200 205
 Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu
 210 215 220
 Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn
 225 230 235 240
 Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu Asn Phe
 245 250 255
 Asp Thr Ala Gln Ile Leu Leu Pro Gln Asn Leu Met Arg Ser Met Ser
 260 265 270
 Ala Pro Leu Arg Leu Ser Gln Leu Phe Val Gln Met Leu Arg Pro Ser
 275 280 285
 Leu Met Thr Pro Ala Arg Arg Met Ala Leu Leu Ala Ser Pro Gln Phe
 290 295 300
 Thr Met Thr Ser Leu Leu Ala Ser Ala Thr Ser Trp Phe Leu Thr Phe
 305 310 315 320

<210> 221
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 <212> DNA
 <213> Corynebacterium glutamicum

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 <222> (1)..(762)
 <223> FRXA01180

<400> 221
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 tac gcg cta ttt atc gtg tcc cgt ttc cgc aat gag ttg att tct cag 96
 Tyr Ala Leu Phe Ile Val Ser Arg Phe Arg Asn Glu Leu Ile Ser Gln
 20 25 30
 act ggc gct aat gat ctg gag cca aag gaa ttg gct gag cgt ctg cgc 144
 Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg
 35 40 45

acc atg ccg ttg gct gct cgt gcg cat gcg atg gga atg gct gtg ggc 192
 Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly
 50 55 60

act gcg ggt tct gcg gtt gta ttc gcg ggt acc acg gtg ctg atc gct 240
 Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala
 65 70 75 80

ctg gtt gct ctg tcg atc att aat att cca ttt cta acc gtg atg gcc 288
 Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala
 85 90 95

att gct gcc gca atc acc gtt gcc atc gca gtt ctg gtt gct ctg tcc 336
 Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser
 100 105 110

ttc ctc cca gct ctg ctt ggc ctg ctt ggc act cgc atc ttc gca gca 384
 Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala
 115 120 125

cgc gtg cct gga cct aag gtt ccg gat cct gag gac gag aag cca acg 432
 Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr
 130 135 140

atg ggt ctg aag tgg gtc cgc ctt gtg cgc aag atg ccg gtg gct tac 480
 Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr
 145 150 155 160

ctg ctg gtt ggc gtc gtt ttg ctt ggt gca atc gca att cct gcg acc 528
 Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr
 165 170 175

aat atg cgc ctg gcc atg ccg act gat ggc acc tcc acg ctg ggc acc 576
 Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr
 180 185 190

gcg ccg cgc acg ggg tat gac atg acg gca gat gcg ttc ggc ccg ggc 624
 Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly
 195 200 205

cgc aac gcg ccc atg att gcg ctt atc gac gca acc gac gtc cct gag 672
 Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu
 210 215 220

gaa gaa cgc cca ttg gtg ttt gga cag gcg gtg gag caa ttc ttg aac 720
 Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn
 225 230 235 240

act gat ggt gtg aag aat gct cag atc act cag acc acg gag 762
 Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu
 245 250

<210> 222

<211> 254

<212> PRT

<213> Corynebacterium glutamicum

<400> 222

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Met Thr Pro Thr Leu Ala Ser Met Ile Gly Leu Ala Val Gly Ile Asp
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Tyr Ala Leu Phe Ile Val Ser Arg Phe Arg Asn Glu Leu Ile Ser Gln
      20           25           30

Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg
      35           40           45

Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly
      50           55           60

Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala
      65           70           75           80

Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala
      85           90           95

Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser
      100          105          110

Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala
      115          120          125

Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr
      130          135          140

Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr
      145          150          155          160

Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr
      165          170          175

Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr
      180          185          190

Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly
      195          200          205

Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu
      210          215          220

Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn
      225          230          235          240

Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu
      245          250

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<211> 393

<212> DNA

<213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(370)
 <223> RXA02586

<400> 223

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gatgccacca tcatccgcat gctgcttgtc ccccgccgtg atg cac ctg ctt cgc 115
                                         Met His Leu Leu Arg
                                         1             5

gac gac aac tgg tgg gca ccc ggc ttc gtt aaa aag gcc tac acc gtc 163
Asp Asp Asn Trp Trp Ala Pro Gly Phe Val Lys Lys Ala Tyr Thr Val
              10              15              20

atg ggt cac ggc tct gag gtg gag gaa gca cct cgc cca acc acc cgt 211
Met Gly His Gly Ser Glu Val Glu Glu Ala Pro Arg Pro Thr Thr Arg
              25              30              35

cgc ctc aac gac gat gag gaa gtc acc gtg cat gaa gca gtt gtc gct 259
Arg Leu Asn Asp Asp Glu Glu Val Thr Val His Glu Ala Val Val Ala
              40              45              50

ggc gat acc gtg gca tct cgc ggt ggt ttg agc acg cag gaa aac cgt 307
Gly Asp Thr Val Ala Ser Arg Gly Gly Leu Ser Thr Gln Glu Asn Arg
              55              60              65

gat ctg gtg tcc ttc gtg gaa ctt aag gct cgt ttg gaa aag cgc agg 355
Asp Leu Val Ser Phe Val Glu Leu Lys Ala Arg Leu Glu Lys Arg Arg
              70              75              80              85

ctt gag gat cta gat taaatctatg cgaggatttt tca 393
Leu Glu Asp Leu Asp
              90

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<210> 224
 <211> 90
 <212> PRT
 <213> *Corynebacterium glutamicum*

<400> 224

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Met His Leu Leu Arg Asp Asp Asn Trp Trp Ala Pro Gly Phe Val Lys
  1             5             10             15

Lys Ala Tyr Thr Val Met Gly His Gly Ser Glu Val Glu Glu Ala Pro
      20             25             30

Arg Pro Thr Thr Arg Arg Leu Asn Asp Asp Glu Glu Val Thr Val His
      35             40             45

Glu Ala Val Val Ala Gly Asp Thr Val Ala Ser Arg Gly Gly Leu Ser
      50             55             60

Thr Gln Glu Asn Arg Asp Leu Val Ser Phe Val Glu Leu Lys Ala Arg
      65             70             75             80

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Leu Glu Lys Arg Arg Leu Glu Asp Leu Asp
 85 90

<210> 225

<211> 2214

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(2191)

<223> RXA02587

<400> 225

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ttgttatcca accgccacaa ttcccaggag taatccaccc gtg ttt tct aaa tgg 115
                               Val Phe Ser Lys Trp
                               1                               5

ggc cac ttt gct tac aga ttt agg cgc att gtt ccg tta gtc gtc atc 163
Gly His Phe Ala Tyr Arg Phe Arg Arg Ile Val Pro Leu Val Val Ile
                10                15                20

gcc gcg att ttg gct ttg ttt gtc att ttc ggc acc aag ctg ggc gac 211
Ala Ala Ile Leu Ala Leu Phe Val Ile Phe Gly Thr Lys Leu Gly Asp
                25                30                35

cgc atg agc cag gaa gga tgg gat gat cct ggt tct tcc tcg acc gct 259
Arg Met Ser Gln Glu Gly Trp Asp Asp Pro Gly Ser Ser Ser Thr Ala
                40                45                50

gcg gcg cgc atc gag ttg gag acc ttt ggg cgt gac aat gac ggc gat 307
Ala Ala Arg Ile Glu Leu Glu Thr Phe Gly Arg Asp Asn Asp Gly Asp
                55                60                65

gtc gtg ttg ctg ttt act gcg cct gaa ggc act tct ttc gat gat gca 355
Val Val Leu Leu Phe Thr Ala Pro Glu Gly Thr Ser Phe Asp Asp Ala
                70                75                80                85

gag gtg ttc tcc agc atc tct ggc tac tta gat ggg cta atc gag aac 403
Glu Val Phe Ser Ser Ile Ser Gly Tyr Leu Asp Gly Leu Ile Glu Asn
                90                95                100

aac cct gat gaa gtc agc cac atc aac agc tac ttt gac act cgt aat 451
Asn Pro Asp Glu Val Ser His Ile Asn Ser Tyr Phe Asp Thr Arg Asn
                105                110                115

caa aat ctc ctc agc aaa gac ggc acc caa acc ttt gca gct ctc ggg 499
Gln Asn Leu Leu Ser Lys Asp Gly Thr Gln Thr Phe Ala Ala Leu Gly
                120                125                130

ctc aaa ggt gac ggc gag caa acg ctg aag gac ttc cgg gag att gaa 547
Leu Lys Gly Asp Gly Glu Gln Thr Leu Lys Asp Phe Arg Glu Ile Glu
                135                140                145

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| | |
|---|------|
| gat cag ctc cat ccg gac aac ctt gcc ggt ggc gtc acc act gag gtc | 595 |
| Asp Gln Leu His Pro Asp Asn Leu Ala Gly Gly Val Thr Thr Glu Val | |
| 150 155 160 165 | |
| gcg ggt gcc acc gct gta gcc gac gca ctc gat gag ggc atg gct ggc | 643 |
| Ala Gly Ala Thr Ala Val Ala Asp Ala Leu Asp Glu Gly Met Ala Gly | |
| 170 175 180 | |
| gat att tca cgc gcc gaa gtt ttt gcg ctg cct ttc gtg gct atc ttg | 691 |
| Asp Ile Ser Arg Ala Glu Val Phe Ala Leu Pro Phe Val Ala Ile Leu | |
| 185 190 195 | |
| ctg ctc atc gtg ttt ggc tca gtt gtt gcc gcg gcg atg cca ttg atc | 739 |
| Leu Leu Ile Val Phe Gly Ser Val Val Ala Ala Ala Met Pro Leu Ile | |
| 200 205 210 | |
| gtg ggc att ttg tcc atc ttg ggt tcg ctg ggc atc ttg gca att ttg | 787 |
| Val Gly Ile Leu Ser Ile Leu Gly Ser Leu Gly Ile Leu Ala Ile Leu | |
| 215 220 225 | |
| gct gga ttc ttc cag gtc aac gta ttt gca caa tct gtt gtg acc ctt | 835 |
| Ala Gly Phe Phe Gln Val Asn Val Phe Ala Gln Ser Val Val Thr Leu | |
| 230 235 240 245 | |
| ctg ggc ttg ggt ctt gcc att gac tat ggc tta ttc atg gtc tct cgt | 883 |
| Leu Gly Leu Gly Leu Ala Ile Asp Tyr Gly Leu Phe Met Val Ser Arg | |
| 250 255 260 | |
| ttc cgt gag gaa atg gat aag ggc acc ccg gtt gaa cag gct gtt gcc | 931 |
| Phe Arg Glu Glu Met Asp Lys Gly Thr Pro Val Glu Gln Ala Val Ala | |
| 265 270 275 | |
| acc act acg gcg acc gcg ggt aag act gtg gtg ttc tct gca gcg atg | 979 |
| Thr Thr Thr Ala Thr Ala Gly Lys Thr Val Val Phe Ser Ala Ala Met | |
| 280 285 290 | |
| gtg gct gtg gcg ctg tcc ggg ttg ttt gtt ttc cca cag gct ttc ttg | 1027 |
| Val Ala Val Ala Leu Ser Gly Leu Phe Val Phe Pro Gln Ala Phe Leu | |
| 295 300 305 | |
| aag tcg gtg gca ttc ggt gcg att tcc gcg gtt ggc ctt gct gct ttg | 1075 |
| Lys Ser Val Ala Phe Gly Ala Ile Ser Ala Val Gly Leu Ala Ala Leu | |
| 310 315 320 325 | |
| atg tcg gtg acg gtg ttg ccg tcg ctg ttc agc atg ttg ggt aag aat | 1123 |
| Met Ser Val Thr Val Leu Pro Ser Leu Phe Ser Met Leu Gly Lys Asn | |
| 330 335 340 | |
| atc gat aag tgg agt ttg cgt cgc act gct cga aca gcg cgc cgt ttg | 1171 |
| Ile Asp Lys Trp Ser Leu Arg Arg Thr Ala Arg Thr Ala Arg Arg Leu | |
| 345 350 355 | |
| gaa gac acc att tgg tac cgc gtg ccg gca tgg gca atg cgc cat gcc | 1219 |
| Glu Asp Thr Ile Trp Tyr Arg Val Pro Ala Trp Ala Met Arg His Ala | |
| 360 365 370 | |

| | |
|---|------|
| aag gca gtg acc gtg ggc gtc gta ttg ctc ttg ctt gct ctt aca gtg | 1267 |
| Lys Ala Val Thr Val Gly Val Val Leu Leu Leu Leu Ala Leu Thr Val | |
| 375 380 385 | |
| ccg ttg acg ggc gtg aaa ttc ggc ggc atc aat gaa acg tat ctg cca | 1315 |
| Pro Leu Thr Gly Val Lys Phe Gly Gly Ile Asn Glu Thr Tyr Leu Pro | |
| 390 395 400 405 | |
| cca gct aac gac acc cgc gtc gcc caa gag cgt ttc gac gag gcg ttt | 1363 |
| Pro Ala Asn Asp Thr Arg Val Ala Gln Glu Arg Phe Asp Glu Ala Phe | |
| 410 415 420 | |
| ccc gcc ttc cgc acc gag ccg gtc aag ctt gtg gtc acc ggg gcg gac | 1411 |
| Pro Ala Phe Arg Thr Glu Pro Val Lys Leu Val Val Thr Gly Ala Asp | |
| 425 430 435 | |
| aac aac cag ctg atc gat atc tat gtt cag gcc aac gaa gtt gag gga | 1459 |
| Asn Asn Gln Leu Ile Asp Ile Tyr Val Gln Ala Asn Glu Val Glu Gly | |
| 440 445 450 | |
| ctg aca gat cgt ttc acc gca ggt gcg act acc gat gat ggc acc acg | 1507 |
| Leu Thr Asp Arg Phe Thr Ala Gly Ala Thr Thr Asp Asp Gly Thr Thr | |
| 455 460 465 | |
| gtg ttg tct act ggt att cag gat cgt tcc ctc aat gag cag gta gtg | 1555 |
| Val Leu Ser Thr Gly Ile Gln Asp Arg Ser Leu Asn Glu Gln Val Val | |
| 470 475 480 485 | |
| gag cag ctt cgc gct att tcc gtc cct gag ggc gtt gag gtg cag atc | 1603 |
| Glu Gln Leu Arg Ala Ile Ser Val Pro Glu Gly Val Glu Val Gln Ile | |
| 490 495 500 | |
| ggt ggc act cca gcc atg gag atc gaa tcc att gag gcg ctc ttt gaa | 1651 |
| Gly Gly Thr Pro Ala Met Glu Ile Glu Ser Ile Glu Ala Leu Phe Glu | |
| 505 510 515 | |
| aag ctc ctc tgg atg gct ctc tac att gtg ctg gcc act ttc atc ctc | 1699 |
| Lys Leu Leu Trp Met Ala Leu Tyr Ile Val Leu Ala Thr Phe Ile Leu | |
| 520 525 530 | |
| atg gca ttg gta ttt ggt tcg gtg att ttg ccg gcg aag gcc atc atc | 1747 |
| Met Ala Leu Val Phe Gly Ser Val Ile Leu Pro Ala Lys Ala Ile Ile | |
| 535 540 545 | |
| atg acc att ctg ggt atg ggt gcc acc ttg ggt att ctc acc ttg atg | 1795 |
| Met Thr Ile Leu Gly Met Gly Ala Thr Leu Gly Ile Leu Thr Leu Met | |
| 550 555 560 565 | |
| ttc gtc gat ggc gtg ggt gcc agc gca ttg aac ttc tcc cct ggc cca | 1843 |
| Phe Val Asp Gly Val Gly Ala Ser Ala Leu Asn Phe Ser Pro Gly Pro | |
| 570 575 580 | |
| ctg atg agt cca gtg ctg gtg ctg atc atg gct att att tac gga ctt | 1891 |
| Leu Met Ser Pro Val Leu Val Leu Ile Met Ala Ile Ile Tyr Gly Leu | |
| 585 590 595 | |
| tcc acc gac tat gag gtg ttc ctg gta tct cgc atg gtg gag gcc cgc | 1939 |

Ser Thr Asp Tyr Glu Val Phe Leu Val Ser Arg Met Val Glu Ala Arg
600 605 610

gat aaa ggc gaa tcc acc gac gac gcc atc aga tac ggc act gca cac 1987
Asp Lys Gly Glu Ser Thr Asp Asp Ala Ile Arg Tyr Gly Thr Ala His
615 620 625

acc gga tct atc atc acc gcg gcc gca ctg atc atg att gtg gtc tgt 2035
Thr Gly Ser Ile Ile Thr Ala Ala Ala Leu Ile Met Ile Val Val Cys
630 635 640 645

gga gcg ttt ggt ttc tct gag atc gtc atg atg aag tac atc gcg ttc 2083
Gly Ala Phe Gly Phe Ser Glu Ile Val Met Met Lys Tyr Ile Ala Phe
650 655 660

ggc atg atc gca gcg ctg att ctg gat gcc acc atc atc cgc atg ctg 2131
Gly Met Ile Ala Ala Leu Ile Leu Asp Ala Thr Ile Ile Arg Met Leu
665 670 675

ctt gtc ccc cgc cgt gat gca cct gct tcg cga cga caa ctg gtg ggc 2179
Leu Val Pro Arg Arg Asp Ala Pro Ala Ser Arg Arg Gln Leu Val Gly
680 685 690

acc cgg ctt cgt taaaaaggcc tacaccgtca tgg 2214
Thr Arg Leu Arg
695

<210> 226

<211> 697

<212> PRT

<213> Corynebacterium glutamicum

<400> 226

Val Phe Ser Lys Trp Gly His Phe Ala Tyr Arg Phe Arg Arg Ile Val
1 5 10 15

Pro Leu Val Val Ile Ala Ala Ile Leu Ala Leu Phe Val Ile Phe Gly
20 25 30

Thr Lys Leu Gly Asp Arg Met Ser Gln Glu Gly Trp Asp Asp Pro Gly
35 40 45

Ser Ser Ser Thr Ala Ala Ala Arg Ile Glu Leu Glu Thr Phe Gly Arg
50 55 60

Asp Asn Asp Gly Asp Val Val Leu Leu Phe Thr Ala Pro Glu Gly Thr
65 70 75 80

Ser Phe Asp Asp Ala Glu Val Phe Ser Ser Ile Ser Gly Tyr Leu Asp
85 90 95

Gly Leu Ile Glu Asn Asn Pro Asp Glu Val Ser His Ile Asn Ser Tyr
100 105 110

Phe Asp Thr Arg Asn Gln Asn Leu Leu Ser Lys Asp Gly Thr Gln Thr
115 120 125

Phe Ala Ala Leu Gly Leu Lys Gly Asp Gly Glu Gln Thr Leu Lys Asp
 130 135 140
 Phe Arg Glu Ile Glu Asp Gln Leu His Pro Asp Asn Leu Ala Gly Gly
 145 150 155 160
 Val Thr Thr Glu Val Ala Gly Ala Thr Ala Val Ala Asp Ala Leu Asp
 165 170 175
 Glu Gly Met Ala Gly Asp Ile Ser Arg Ala Glu Val Phe Ala Leu Pro
 180 185 190
 Phe Val Ala Ile Leu Leu Leu Ile Val Phe Gly Ser Val Val Ala Ala
 195 200 205
 Ala Met Pro Leu Ile Val Gly Ile Leu Ser Ile Leu Gly Ser Leu Gly
 210 215 220
 Ile Leu Ala Ile Leu Ala Gly Phe Phe Gln Val Asn Val Phe Ala Gln
 225 230 235 240
 Ser Val Val Thr Leu Leu Gly Leu Gly Leu Ala Ile Asp Tyr Gly Leu
 245 250 255
 Phe Met Val Ser Arg Phe Arg Glu Glu Met Asp Lys Gly Thr Pro Val
 260 265 270
 Glu Gln Ala Val Ala Thr Thr Thr Ala Thr Ala Gly Lys Thr Val Val
 275 280 285
 Phe Ser Ala Ala Met Val Ala Val Ala Leu Ser Gly Leu Phe Val Phe
 290 295 300
 Pro Gln Ala Phe Leu Lys Ser Val Ala Phe Gly Ala Ile Ser Ala Val
 305 310 315 320
 Gly Leu Ala Ala Leu Met Ser Val Thr Val Leu Pro Ser Leu Phe Ser
 325 330 335
 Met Leu Gly Lys Asn Ile Asp Lys Trp Ser Leu Arg Arg Thr Ala Arg
 340 345 350
 Thr Ala Arg Arg Leu Glu Asp Thr Ile Trp Tyr Arg Val Pro Ala Trp
 355 360 365
 Ala Met Arg His Ala Lys Ala Val Thr Val Gly Val Val Leu Leu Leu
 370 375 380
 Leu Ala Leu Thr Val Pro Leu Thr Gly Val Lys Phe Gly Gly Ile Asn
 385 390 395 400
 Glu Thr Tyr Leu Pro Pro Ala Asn Asp Thr Arg Val Ala Gln Glu Arg
 405 410 415
 Phe Asp Glu Ala Phe Pro Ala Phe Arg Thr Glu Pro Val Lys Leu Val
 420 425 430

Val Thr Gly Ala Asp Asn Asn Gln Leu Ile Asp Ile Tyr Val Gln Ala
 435 440 445
 Asn Glu Val Glu Gly Leu Thr Asp Arg Phe Thr Ala Gly Ala Thr Thr
 450 455 460
 Asp Asp Gly Thr Thr Val Leu Ser Thr Gly Ile Gln Asp Arg Ser Leu
 465 470 475 480
 Asn Glu Gln Val Val Glu Gln Leu Arg Ala Ile Ser Val Pro Glu Gly
 485 490 495
 Val Glu Val Gln Ile Gly Gly Thr Pro Ala Met Glu Ile Glu Ser Ile
 500 505 510
 Glu Ala Leu Phe Glu Lys Leu Leu Trp Met Ala Leu Tyr Ile Val Leu
 515 520 525
 Ala Thr Phe Ile Leu Met Ala Leu Val Phe Gly Ser Val Ile Leu Pro
 530 535 540
 Ala Lys Ala Ile Ile Met Thr Ile Leu Gly Met Gly Ala Thr Leu Gly
 545 550 555 560
 Ile Leu Thr Leu Met Phe Val Asp Gly Val Gly Ala Ser Ala Leu Asn
 565 570 575
 Phe Ser Pro Gly Pro Leu Met Ser Pro Val Leu Val Leu Ile Met Ala
 580 585 590
 Ile Ile Tyr Gly Leu Ser Thr Asp Tyr Glu Val Phe Leu Val Ser Arg
 595 600 605
 Met Val Glu Ala Arg Asp Lys Gly Glu Ser Thr Asp Asp Ala Ile Arg
 610 615 620
 Tyr Gly Thr Ala His Thr Gly Ser Ile Ile Thr Ala Ala Ala Leu Ile
 625 630 635 640
 Met Ile Val Val Cys Gly Ala Phe Gly Phe Ser Glu Ile Val Met Met
 645 650 655
 Lys Tyr Ile Ala Phe Gly Met Ile Ala Ala Leu Ile Leu Asp Ala Thr
 660 665 670
 Ile Ile Arg Met Leu Leu Val Pro Arg Arg Asp Ala Pro Ala Ser Arg
 675 680 685
 Arg Gln Leu Val Gly Thr Arg Leu Arg
 690 695

<210> 227

<211> 729

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(706)

<223> RXN03042

<400> 227

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tcgcctcggc gacgtcctgg ttccttacgt tctgatcggt ttg gtt cta gcg ttc 115
                                   Leu Val Leu Ala Phe
                                   1                               5

ctc gtg ctg ttg ctc gtg ttc cgg tcc att tgg gtc cca ttg atc gcg 163
Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp Val Pro Leu Ile Ala
              10                      15                      20

gct ctg ggc ttt ggc ttg tca gtt ctg gct acc ttt ggt gct acc gtg 211
Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr Phe Gly Ala Thr Val
              25                      30                      35

gcg atc ttc caa gaa ggt gct ttc ggc atc atc gac gat cct cag cca 259
Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile Asp Asp Pro Gln Pro
              40                      45                      50

ctg ctg tcc ttc ttg ccg atc atg ctc atc ggc ctg gta ttt ggt ctg 307
Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly Leu Val Phe Gly Leu
              55                      60                      65

gcc atg gat tac cag atc ttc ctc gtt act cgt atg cgt gag ggc ttc 355
Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg Met Arg Glu Gly Phe
              70                      75                      80                      85

acc aag ggc aag act gcg ggc aac gca acg tcg aat ggt ttc aag cac 403
Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser Asn Gly Phe Lys His
              90                      95                      100

ggt gcc cgc gtg gtc act ggt gcg gcg ctg atc atg gtg tct gtg ttc 451
Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile Met Val Ser Val Phe
              105                      110                      115

gcg gca ttc ata gcg cag gac atg gcg ttt att aag acc atg ggc ttt 499
Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile Lys Thr Met Gly Phe
              120                      125                      130

gct ctg gcc gtt gct gtg ttc ttc gat gcc ttc gtt gtt cgc atg atg 547
Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe Val Val Arg Met Met
              135                      140                      145

att atc cct gca aca atg ttc ctg ctt gat gac aag gct tgg tgg cta 595
Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp Lys Ala Trp Trp Leu
              150                      155                      160                      165

cct aag tgg ttg gat aag att ctt ccc aac gtt gat gtt gaa ggt gag 643
Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val Asp Val Glu Gly Glu
              170                      175                      180

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ggt ctt agt gaa cta cat gag gct cgc acc gag gaa ctg aag gaa aat 691
 Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu Glu Leu Lys Glu Asn
 185 190 195

gta ggt gtc ggg gct tagagaaaca aaaaaggctg cta 729
 Val Gly Val Gly Ala
 200

<210> 228

<211> 202

<212> PRT

<213> Corynebacterium glutamicum

<400> 228

Leu Val Leu Ala Phe Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp
 1 5 10 15

Val Pro Leu Ile Ala Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr
 20 25 30

Phe Gly Ala Thr Val Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile
 35 40 45

Asp Asp Pro Gln Pro Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly
 50 55 60

Leu Val Phe Gly Leu Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg
 65 70 75 80

Met Arg Glu Gly Phe Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser
 85 90 95

Asn Gly Phe Lys His Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile
 100 105 110

Met Val Ser Val Phe Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile
 115 120 125

Lys Thr Met Gly Phe Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe
 130 135 140

Val Val Arg Met Met Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp
 145 150 155 160

Lys Ala Trp Trp Leu Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val
 165 170 175

Asp Val Glu Gly Glu Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu
 180 185 190

Glu Leu Lys Glu Asn Val Gly Val Gly Ala
 195 200

<210> 229

<211> 729

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(706)

<223> FRXA02893

<400> 229

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tcgcctcggc gacgtcctgg ttccttacgt tctgatcggt ttg gtt cta gcg ttc 115
                                   Leu Val Leu Ala Phe
                                   1                               5

ctc gtg ctg ttg ctc gtg ttc cgg tcc att tgg gtc cca ttg atc gcg 163
Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp Val Pro Leu Ile Ala
              10                      15                      20

gct ctg ggc ttt ggc ttg tca gtt ctg gct acc ttt ggt gct acc gtg 211
Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr Phe Gly Ala Thr Val
              25                      30                      35

gcg atc ttc caa gaa ggt gct ttc ggc atc atc gac gat cct cag cca 259
Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile Asp Asp Pro Gln Pro
              40                      45                      50

ctg ctg tcc ttc ttg ccg atc atg ctc atc ggc ctg gta ttt ggt ctg 307
Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly Leu Val Phe Gly Leu
              55                      60                      65

gcc atg gat tac cag atc ttc ctc gtt act cgt atg cgt gag ggc ttc 355
Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg Met Arg Glu Gly Phe
              70                      75                      80                      85

acc aag ggc aag act gcg ggc aac gca acg tcg aat ggt ttc aag cac 403
Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser Asn Gly Phe Lys His
              90                      95                      100

ggt gcc cgc gtg gtc act gct gcg gcg ctg atc atg gtg tct gtg ttc 451
Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile Met Val Ser Val Phe
              105                      110                      115

gcg gca ttc ata gcg cag gac atg gcg ttt att aag acc atg ggc ttt 499
Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile Lys Thr Met Gly Phe
              120                      125                      130

gct ctg gcc gtt gct gtg ttc ttc gat gcc ttc gtt gtt cgc atg atg 547
Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe Val Val Arg Met Met
              135                      140                      145

att atc cct gca aca atg ttc ctg ctt gat gac aag gct tgg tgg cta 595
Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp Lys Ala Trp Trp Leu
              150                      155                      160                      165

cct aag tgg ttg gat aag att ctt ccc aac gtt gat gtt gaa ggt gag 643
Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val Asp Val Glu Gly Glu

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170 175 180
 ggt ctt agt gaa cta cat gag gct cgc acc gag gaa ctg aag gaa aat 691
 Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu Glu Leu Lys Glu Asn
 185 190 195
 gta ggt gtc ggg gct tagagaaaca aaaaaggctg cta 729
 Val Gly Val Gly Ala
 200
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 <400> 230
 Leu Val Leu Ala Phe Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp
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 Val Pro Leu Ile Ala Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr
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 Phe Gly Ala Thr Val Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile
 35 40 45
 Asp Asp Pro Gln Pro Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly
 50 55 60
 Leu Val Phe Gly Leu Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg
 65 70 75 80
 Met Arg Glu Gly Phe Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser
 85 90 95
 Asn Gly Phe Lys His Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile
 100 105 110
 Met Val Ser Val Phe Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile
 115 120 125
 Lys Thr Met Gly Phe Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe
 130 135 140
 Val Val Arg Met Met Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp
 145 150 155 160
 Lys Ala Trp Trp Leu Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val
 165 170 175
 Asp Val Glu Gly Glu Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu
 180 185 190
 Glu Leu Lys Glu Asn Val Gly Val Gly Ala
 195 200

<210> 231
 <211> 1605
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1582)
 <223> RXA01616

<400> 231

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cctacgattt ccgacgtctt aaatcgccac acagcgccgt ggtctaaaac accaacaaaa 60

gagttgtaac tgtaccgacc attcggtaca gttacgatcc atg act tca gaa acc 115
                               Met Thr Ser Glu Thr
                               1                               5

tta cag gcg caa gcg cct acg aaa acc caa cgt tgg gct ttc ctc gcc 163
Leu Gln Ala Gln Ala Pro Thr Lys Thr Gln Arg Trp Ala Phe Leu Ala
                               10                               15                               20

gtt atc agc ggt ggt ctc ttt ctg atc ggt gta gac aac tcg att ctc 211
Val Ile Ser Gly Gly Leu Phe Leu Ile Gly Val Asp Asn Ser Ile Leu
                               25                               30                               35

tac acc gca ctc cct ctg ctg cgt gaa cag ctc gca gcc tcc gaa acc 259
Tyr Thr Ala Leu Pro Leu Leu Arg Glu Gln Leu Ala Ala Ser Glu Thr
                               40                               45                               50

caa gcg ttg tgg atc atc aac gca tat ccc ctg ctc atg gcg ggc ctt 307
Gln Ala Leu Trp Ile Ile Asn Ala Tyr Pro Leu Leu Met Ala Gly Leu
                               55                               60                               65

cgt ttg ggt gcc ggc act ttg ggt gac aaa aac ggc cac cgc cgg atg 355
Arg Leu Gly Ala Gly Thr Leu Gly Asp Lys Asn Gly His Arg Arg Met
   70                               75                               80                               85

ttc ctc atg ggc ttg agc att ttc gga atc gct tca ctt ggt gct gcg 403
Phe Leu Met Gly Leu Ser Ile Phe Gly Ile Ala Ser Leu Gly Ala Ala
                               90                               95                               100

ttt gct cca act gcg tgg gct ctt gtt gct gcg aga gct ttc ctt ggc 451
Phe Ala Pro Thr Ala Trp Ala Leu Val Ala Ala Arg Ala Phe Leu Gly
                               105                               110                               115

atc ggt gcg gca acg atg atg cct gca acc ttg gct ctg atc cgc att 499
Ile Gly Ala Ala Thr Met Met Pro Ala Thr Leu Ala Leu Ile Arg Ile
                               120                               125                               130

acg ttt gag gat gag cgt gag cgc aac act gca att ggt att tgg ggt 547
Thr Phe Glu Asp Glu Arg Glu Arg Asn Thr Ala Ile Gly Ile Trp Gly
                               135                               140                               145

tcc gtg gca att ctt ggc gct gcg gca ggc ccg atc att ggt ggt gcg 595
Ser Val Ala Ile Leu Gly Ala Ala Ala Gly Pro Ile Ile Gly Gly Ala
   150                               155                               160                               165

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| | |
|---|------|
| ctg ttg gaa ttc ttc tgg tgg ggt tcg gtt ttc ctc att aac gtt ccg Leu Leu Glu Phe Phe Trp Trp Gly Ser Val Phe Leu Ile Asn Val Pro 170 175 180 | 643 |
| gtg gct gtt atc gcg ttg atc gct acg ctt ttt gtg gcg ccg gcc aat Val Ala Val Ile Ala Leu Ile Ala Thr Leu Phe Val Ala Pro Ala Asn 185 190 195 | 691 |
| atc gcg aat ccg tct aag cat tgg gat ttc ttg tcg tcg ttc tat gcg Ile Ala Asn Pro Ser Lys His Trp Asp Phe Leu Ser Ser Phe Tyr Ala 200 205 210 | 739 |
| ctg ctc aca ctt gct ggg ttg atc atc acg atc aag gaa tct gtg aat Leu Leu Thr Leu Ala Gly Leu Ile Ile Thr Ile Lys Glu Ser Val Asn 215 220 225 | 787 |
| act gca cgc cat atg cct ctt ctt ttg ggt gca gtc atc atg ttg atc Thr Ala Arg His Met Pro Leu Leu Leu Gly Ala Val Ile Met Leu Ile 230 235 240 245 | 835 |
| att ggt gcg gtg ttg ttt agc agt cgt cag aag aag atc gag gag cca Ile Gly Ala Val Leu Phe Ser Ser Arg Gln Lys Lys Ile Glu Glu Pro 250 255 260 | 883 |
| ctt cta gat ctg tcg ttg ttc cgt aat cgc ctt ttc tta ggc ggt gtg Leu Leu Asp Leu Ser Leu Phe Arg Asn Arg Leu Phe Leu Gly Gly Val 265 270 275 | 931 |
| gtt gct gcg ggc atg gcg atg ttt act gtg tcc ggt ttg gaa atg act Val Ala Ala Gly Met Ala Met Phe Thr Val Ser Gly Leu Glu Met Thr 280 285 290 | 979 |
| acc tcg cag cgt ttc cag ttg tct gtg ggt ttc act cca ctt gag gct Thr Ser Gln Arg Phe Gln Leu Ser Val Gly Phe Thr Pro Leu Glu Ala 295 300 305 | 1027 |
| ggt ttg ctc atg atc cca gct gca ttg ggt agc ttc ccg atg tct att Gly Leu Leu Met Ile Pro Ala Ala Leu Gly Ser Phe Pro Met Ser Ile 310 315 320 325 | 1075 |
| atc ggt ggt gca aac ctg cat cgt tgg ggc ttc aaa ccg ctg atc agt Ile Gly Gly Ala Asn Leu His Arg Trp Gly Phe Lys Pro Leu Ile Ser 330 335 340 | 1123 |
| ggt ggt ttt gct gcc act gcc gtt ggc atc gcc ctg tgt att tgg ggc Gly Gly Phe Ala Ala Thr Ala Val Gly Ile Ala Leu Cys Ile Trp Gly 345 350 355 | 1171 |
| gcg act cat act gat ggt ttg ccg ttt ttc atc gcg ggt cta ttc ttc Ala Thr His Thr Asp Gly Leu Pro Phe Phe Ile Ala Gly Leu Phe Phe 360 365 370 | 1219 |
| atg ggc gcg ggt gct ggt tcg gta atg tct gtg tct tcc act gcg att Met Gly Ala Gly Ala Gly Ser Val Met Ser Val Ser Ser Thr Ala Ile 375 380 385 | 1267 |
| atc ggt tcc gcg ccg gtg cgt aag gct ggc atg gcg tcg tcg atc gaa | 1315 |

Ile Gly Ser Ala Pro Val Arg Lys Ala Gly Met Ala Ser Ser Ile Glu
 390 395 400 405
 gag gtc tct tat gag ttc ggc acg ctg ttg tct gtc gcg att ttg ggt 1363
 Glu Val Ser Tyr Glu Phe Gly Thr Leu Leu Ser Val Ala Ile Leu Gly
 410 415 420
 agc ttg ttc cca ttc ttc tac tcg ctg cat gcc ccg gca gag gtt gcg 1411
 Ser Leu Phe Pro Phe Phe Tyr Ser Leu His Ala Pro Ala Glu Val Ala
 425 430 435
 gat aac ttc tcg gcg ggt gtt cac cac gcg att gat ggc gat gcg gcg 1459
 Asp Asn Phe Ser Ala Gly Val His His Ala Ile Asp Gly Asp Ala Ala
 440 445 450
 cgt gca tct ttg gac acc gca tac att aac gtg ttg atc att gcc cta 1507
 Arg Ala Ser Leu Asp Thr Ala Tyr Ile Asn Val Leu Ile Ile Ala Leu
 455 460 465
 gta tgc gca gta gcg gct gct ctg atc agc agt tac ctt ttc cgc gga 1555
 Val Cys Ala Val Ala Ala Ala Leu Ile Ser Ser Tyr Leu Phe Arg Gly
 470 475 480 485
 aat ccg aag gga gcc aat aat gcg cac tagtaaaaaa gagatgattc 1602
 Asn Pro Lys Gly Ala Asn Asn Ala His
 490
 tgc 1605

 <210> 232
 <211> 494
 <212> PRT
 <213> Corynebacterium glutamicum

 <400> 232
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 1 5 10 15
 Trp Ala Phe Leu Ala Val Ile Ser Gly Gly Leu Phe Leu Ile Gly Val
 20 25 30
 Asp Asn Ser Ile Leu Tyr Thr Ala Leu Pro Leu Leu Arg Glu Gln Leu
 35 40 45
 Ala Ala Ser Glu Thr Gln Ala Leu Trp Ile Ile Asn Ala Tyr Pro Leu
 50 55 60
 Leu Met Ala Gly Leu Arg Leu Gly Ala Gly Thr Leu Gly Asp Lys Asn
 65 70 75 80
 Gly His Arg Arg Met Phe Leu Met Gly Leu Ser Ile Phe Gly Ile Ala
 85 90 95
 Ser Leu Gly Ala Ala Phe Ala Pro Thr Ala Trp Ala Leu Val Ala Ala
 100 105 110

Arg Ala Phe Leu Gly Ile Gly Ala Ala Thr Met Met Pro Ala Thr Leu
 115 120 125
 Ala Leu Ile Arg Ile Thr Phe Glu Asp Glu Arg Glu Arg Asn Thr Ala
 130 135 140
 Ile Gly Ile Trp Gly Ser Val Ala Ile Leu Gly Ala Ala Ala Gly Pro
 145 150 155 160
 Ile Ile Gly Gly Ala Leu Leu Glu Phe Phe Trp Trp Gly Ser Val Phe
 165 170 175
 Leu Ile Asn Val Pro Val Ala Val Ile Ala Leu Ile Ala Thr Leu Phe
 180 185 190
 Val Ala Pro Ala Asn Ile Ala Asn Pro Ser Lys His Trp Asp Phe Leu
 195 200 205
 Ser Ser Phe Tyr Ala Leu Leu Thr Leu Ala Gly Leu Ile Ile Thr Ile
 210 215 220
 Lys Glu Ser Val Asn Thr Ala Arg His Met Pro Leu Leu Leu Gly Ala
 225 230 235 240
 Val Ile Met Leu Ile Ile Gly Ala Val Leu Phe Ser Ser Arg Gln Lys
 245 250 255
 Lys Ile Glu Glu Pro Leu Leu Asp Leu Ser Leu Phe Arg Asn Arg Leu
 260 265 270
 Phe Leu Gly Gly Val Val Ala Ala Gly Met Ala Met Phe Thr Val Ser
 275 280 285
 Gly Leu Glu Met Thr Thr Ser Gln Arg Phe Gln Leu Ser Val Gly Phe
 290 295 300
 Thr Pro Leu Glu Ala Gly Leu Leu Met Ile Pro Ala Ala Leu Gly Ser
 305 310 315 320
 Phe Pro Met Ser Ile Ile Gly Gly Ala Asn Leu His Arg Trp Gly Phe
 325 330 335
 Lys Pro Leu Ile Ser Gly Gly Phe Ala Ala Thr Ala Val Gly Ile Ala
 340 345 350
 Leu Cys Ile Trp Gly Ala Thr His Thr Asp Gly Leu Pro Phe Phe Ile
 355 360 365
 Ala Gly Leu Phe Phe Met Gly Ala Gly Ala Gly Ser Val Met Ser Val
 370 375 380
 Ser Ser Thr Ala Ile Ile Gly Ser Ala Pro Val Arg Lys Ala Gly Met
 385 390 395 400
 Ala Ser Ser Ile Glu Glu Val Ser Tyr Glu Phe Gly Thr Leu Leu Ser
 405 410 415

Val Ala Ile Leu Gly Ser Leu Phe Pro Phe Phe Tyr Ser Leu His Ala
 420 425 430

Pro Ala Glu Val Ala Asp Asn Phe Ser Ala Gly Val His His Ala Ile
 435 440 445

Asp Gly Asp Ala Ala Arg Ala Ser Leu Asp Thr Ala Tyr Ile Asn Val
 450 455 460

Leu Ile Ile Ala Leu Val Cys Ala Val Ala Ala Ala Leu Ile Ser Ser
 465 470 475 480

Tyr Leu Phe Arg Gly Asn Pro Lys Gly Ala Asn Asn Ala His
 485 490

<210> 233

<211> 1500

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1477)

<223> RXA01666

<400> 233

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agtttgaggg tttttgctcc ccattctttag gagacacccc gtg tcc acg ttt cat 115
 Val Ser Thr Phe His
 1 5

aaa gtt ttg atc aac acc atg atc tcc aac gtc acc act gga ttt ctg 163
 Lys Val Leu Ile Asn Thr Met Ile Ser Asn Val Thr Thr Gly Phe Leu
 10 15 20

ttc ttt gcc gtg gtg ttt tgg atg tat ctt tcc act ggc aac gtc gca 211
 Phe Phe Ala Val Val Phe Trp Met Tyr Leu Ser Thr Gly Asn Val Ala
 25 30 35

ctg acc ggc atc gtc agt gga att tac atg ggt ttg atc gcc gtt tgt 259
 Leu Thr Gly Ile Val Ser Gly Ile Tyr Met Gly Leu Ile Ala Val Cys
 40 45 50

tcc atc ttt ttc gga acc gtt gtt gat cac aat cgc aag aag tcc gtc 307
 Ser Ile Phe Phe Gly Thr Val Val Asp His Asn Arg Lys Lys Ser Val
 55 60 65

atg ctg ttt tcc agc gtc acc aca ctc gtg ttt tat tgt ctc agt gcc 355
 Met Leu Phe Ser Ser Val Thr Thr Leu Val Phe Tyr Cys Leu Ser Ala
 70 75 80 85

ctg gtg tgg gtg ttt tgg ctg gag gaa gac ggc ctg agc atc gga aat 403
 Leu Val Trp Val Phe Trp Leu Glu Glu Asp Gly Leu Ser Ile Gly Asn
 90 95 100

acc gcc ctg tgg gtg ttc gtt tct ttc atc ctc atc gga tca atc gtg 451
 Thr Ala Leu Trp Val Phe Val Ser Phe Ile Leu Ile Gly Ser Ile Val
 105 110 115

gaa cac atg cgc aac atc gca ctg tcc acc gtg gtc acg ctg ttg gtt 499
 Glu His Met Arg Asn Ile Ala Leu Ser Thr Val Val Thr Leu Leu Val
 120 125 130

cct gaa gct gaa cgc gac aaa gca aac ggc ctg gta gga gcc gtg caa 547
 Pro Glu Ala Glu Arg Asp Lys Ala Asn Gly Leu Val Gly Ala Val Gln
 135 140 145

ggt gtt gga ttt tta gtc acc agc gtc att gct ggt tcc gcc atc ggg 595
 Gly Val Gly Phe Leu Val Thr Ser Val Ile Ala Gly Ser Ala Ile Gly
 150 155 160 165

ttc ttg ggc atg gaa atc acc ctg tgg atc tgc ctt ggg ctc tca ctt 643
 Phe Leu Gly Met Glu Ile Thr Leu Trp Ile Cys Leu Gly Leu Ser Leu
 170 175 180

gtc gcg ctg ctg cac ctg ctg ccg att cgc gtc gac gaa ccg gaa atc 691
 Val Ala Leu Leu His Leu Leu Pro Ile Arg Val Asp Glu Pro Glu Ile
 185 190 195

atc acc caa gaa gac gca cag cct act gtt tct gac gat tca gtt ccc 739
 Ile Thr Gln Glu Asp Ala Gln Pro Thr Val Ser Asp Asp Ser Val Pro
 200 205 210

aca cct acc tcc gat ttg gcg atc gtg tcc aaa ggc atc gac cta aaa 787
 Thr Pro Thr Ser Asp Leu Ala Ile Val Ser Lys Gly Ile Asp Leu Lys
 215 220 225

gga tca atg aaa atc atc ctg agt gtt ccg gga ctg ctc gcg ctt gtg 835
 Gly Ser Met Lys Ile Ile Leu Ser Val Pro Gly Leu Leu Ala Leu Val
 230 235 240 245

ttg ttt gcg tcc ttc aac aac ctc atc ggc ggc gtg tac tcc gca ctc 883
 Leu Phe Ala Ser Phe Asn Asn Leu Ile Gly Gly Val Tyr Ser Ala Leu
 250 255 260

atg gac cct tac ggc ctg gaa ctt ttc agc cca cag ctg tgg ggg cta 931
 Met Asp Pro Tyr Gly Leu Glu Leu Phe Ser Pro Gln Leu Trp Gly Leu
 265 270 275

ctg ctt gga ctc acc agc ctc ggc ttc atc gtt ggt ggt gct gtg atc 979
 Leu Leu Gly Leu Thr Ser Leu Gly Phe Ile Val Gly Gly Ala Val Ile
 280 285 290

tcc aaa act ggc ttg ggc aaa aac cct gtg cgc acc ttg ctg ctg gtt 1027
 Ser Lys Thr Gly Leu Gly Lys Asn Pro Val Arg Thr Leu Leu Leu Val
 295 300 305

aat gtt ggt gtg gct ttt gtt ggc atg tta ttt gcc att cgc gaa tgg 1075
 Asn Val Gly Val Ala Phe Val Gly Met Leu Phe Ala Ile Arg Glu Trp
 310 315 320 325

tgg tgg ctc tac atc ctg ggc att ttc atc ttc atg gct atc acc cca 1123

Trp Trp Leu Tyr Ile Leu Gly Ile Phe Ile Phe Met Ala Ile Thr Pro
 330 335 340
 gct gcc gaa gcc gca gaa caa acc atc ctt caa cga gtc gtc cca ttc 1171
 Ala Ala Glu Ala Ala Glu Gln Thr Ile Leu Gln Arg Val Val Pro Phe
 345 350 355
 cgc caa caa ggc cgc gta ttt gga cta gcc atg gca gtg gaa atg gca 1219
 Arg Gln Gln Gly Arg Val Phe Gly Leu Ala Met Ala Val Glu Met Ala
 360 365 370
 gcc aac ccg ctc tcc aca gtg atc gtg gcg att ttg gcc gaa gcc tac 1267
 Ala Asn Pro Leu Ser Thr Val Ile Val Ala Ile Leu Ala Glu Ala Tyr
 375 380 385
 ctc att cca tgg atg gct ggc ccc ggc gcg gac acc atc tgg ggc gtg 1315
 Leu Ile Pro Trp Met Ala Gly Pro Gly Ala Asp Thr Ile Trp Gly Val
 390 395 400 405
 atc ctc ggc gag ggt aaa gct cgc ggc atg gca ctg atg ttc ctc gca 1363
 Ile Leu Gly Glu Gly Lys Ala Arg Gly Met Ala Leu Met Phe Leu Ala
 410 415 420
 tca ggt gcc atc atg ttg gtt gtc gtg ctg ttg gca ttc atg tcg agg 1411
 Ser Gly Ala Ile Met Leu Val Val Val Leu Leu Ala Phe Met Ser Arg
 425 430 435
 tcc tac cgg aaa ctc agc cag tac tac gcc acc acc agc caa gac att 1459
 Ser Tyr Arg Lys Leu Ser Gln Tyr Tyr Ala Thr Thr Ser Gln Asp Ile
 440 445 450
 gcg gga gct gct gag aag taagtgcctct agaccgttgt ttg 1500
 Ala Gly Ala Ala Glu Lys
 455

<210> 234
 <211> 459
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 234
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 Thr Thr Gly Phe Leu Phe Phe Ala Val Val Phe Trp Met Tyr Leu Ser
 20 25 30
 Thr Gly Asn Val Ala Leu Thr Gly Ile Val Ser Gly Ile Tyr Met Gly
 35 40 45
 Leu Ile Ala Val Cys Ser Ile Phe Phe Gly Thr Val Val Asp His Asn
 50 55 60
 Arg Lys Lys Ser Val Met Leu Phe Ser Ser Val Thr Thr Leu Val Phe
 65 70 75 80

Tyr Cys Leu Ser Ala Leu Val Trp Val Phe Trp Leu Glu Glu Asp Gly
 85 90 95
 Leu Ser Ile Gly Asn Thr Ala Leu Trp Val Phe Val Ser Phe Ile Leu
 100 105 110
 Ile Gly Ser Ile Val Glu His Met Arg Asn Ile Ala Leu Ser Thr Val
 115 120 125
 Val Thr Leu Leu Val Pro Glu Ala Glu Arg Asp Lys Ala Asn Gly Leu
 130 135 140
 Val Gly Ala Val Gln Gly Val Gly Phe Leu Val Thr Ser Val Ile Ala
 145 150 155 160
 Gly Ser Ala Ile Gly Phe Leu Gly Met Glu Ile Thr Leu Trp Ile Cys
 165 170 175
 Leu Gly Leu Ser Leu Val Ala Leu Leu His Leu Leu Pro Ile Arg Val
 180 185 190
 Asp Glu Pro Glu Ile Ile Thr Gln Glu Asp Ala Gln Pro Thr Val Ser
 195 200 205
 Asp Asp Ser Val Pro Thr Pro Thr Ser Asp Leu Ala Ile Val Ser Lys
 210 215 220
 Gly Ile Asp Leu Lys Gly Ser Met Lys Ile Ile Leu Ser Val Pro Gly
 225 230 235 240
 Leu Leu Ala Leu Val Leu Phe Ala Ser Phe Asn Asn Leu Ile Gly Gly
 245 250 255
 Val Tyr Ser Ala Leu Met Asp Pro Tyr Gly Leu Glu Leu Phe Ser Pro
 260 265 270
 Gln Leu Trp Gly Leu Leu Leu Gly Leu Thr Ser Leu Gly Phe Ile Val
 275 280 285
 Gly Gly Ala Val Ile Ser Lys Thr Gly Leu Gly Lys Asn Pro Val Arg
 290 295 300
 Thr Leu Leu Leu Val Asn Val Gly Val Ala Phe Val Gly Met Leu Phe
 305 310 315 320
 Ala Ile Arg Glu Trp Trp Trp Leu Tyr Ile Leu Gly Ile Phe Ile Phe
 325 330 335
 Met Ala Ile Thr Pro Ala Ala Glu Ala Ala Glu Gln Thr Ile Leu Gln
 340 345 350
 Arg Val Val Pro Phe Arg Gln Gln Gly Arg Val Phe Gly Leu Ala Met
 355 360 365
 Ala Val Glu Met Ala Ala Asn Pro Leu Ser Thr Val Ile Val Ala Ile
 370 375 380

Leu Ala Glu Ala Tyr Leu Ile Pro Trp Met Ala Gly Pro Gly Ala Asp
385 390 395 400

Thr Ile Trp Gly Val Ile Leu Gly Glu Gly Lys Ala Arg Gly Met Ala
405 410 415

Leu Met Phe Leu Ala Ser Gly Ala Ile Met Leu Val Val Val Leu Leu
420 425 430

Ala Phe Met Ser Arg Ser Tyr Arg Lys Leu Ser Gln Tyr Tyr Ala Thr
435 440 445

Thr Ser Gln Asp Ile Ala Gly Ala Ala Glu Lys
450 455

<210> 235

<211> 1521

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1498)

<223> RXA00062

<400> 235

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tcactgttgc gttttcttgc tgccatcaaa aattagtcac atg att tta agc atc 115
Met Ile Leu Ser Ile
1 5

gtc ctt ttg ggc tac ttc atg att ctg ctt gac acc tcc atc gtc att 163
Val Leu Leu Gly Tyr Phe Met Ile Leu Leu Asp Thr Ser Ile Val Ile
10 15 20

acg ggt cta cct gcc atc ggc agt gaa ctt ggc atc gat ccc gtg cac 211
Thr Gly Leu Pro Ala Ile Gly Ser Glu Leu Gly Ile Asp Pro Val His
25 30 35

ctg tca tgg gtg cag agt tcc tac aca tta gtc ttc ggc gca ctt ctt 259
Leu Ser Trp Val Gln Ser Ser Tyr Thr Leu Val Phe Gly Ala Leu Leu
40 45 50

ctg ctg gga gct cgt gcc ggt gat atc ttc ggc cga aag aaa gtg ctc 307
Leu Leu Gly Ala Arg Ala Gly Asp Ile Phe Gly Arg Lys Lys Val Leu
55 60 65

tac att ggt ctc gcg ttg ttt gcg gct tca tcg ttg gca att gcg ctt 355
Tyr Ile Gly Leu Ala Leu Phe Ala Ala Ser Ser Leu Ala Ile Ala Leu
70 75 80 85

tct cca aat gct gcg gtc ctc att gga gca cgc gta gtt caa ggc gcg 403
Ser Pro Asn Ala Ala Val Leu Ile Gly Ala Arg Val Val Gln Gly Ala
90 95 100

| | |
|---|------|
| gga gct gcg att atc gct cca gcg aca ctt gcg ttg att act gag ttc | 451 |
| Gly Ala Ala Ile Ile Ala Pro Ala Thr Leu Ala Leu Ile Thr Glu Phe | |
| 105 110 115 | |
| ttc ccc gaa ggc cca gct cgc ctt cgt gct acc tct gct tat ggt gct | 499 |
| Phe Pro Glu Gly Pro Ala Arg Leu Arg Ala Thr Ser Ala Tyr Gly Ala | |
| 120 125 130 | |
| gtt gcc ggc atc ggt gtg gca gca ggc cta gtg atc ggc ggc gta ttt | 547 |
| Val Ala Gly Ile Gly Val Ala Ala Gly Leu Val Ile Gly Gly Val Phe | |
| 135 140 145 | |
| gct gat ctt ttg tcg tgg cgc atc ggc ttc ttt atc aac gtc ccc atc | 595 |
| Ala Asp Leu Leu Ser Trp Arg Ile Gly Phe Phe Ile Asn Val Pro Ile | |
| 150 155 160 165 | |
| gcc gca gtg ttg gcc tac ata gtg cac aaa gcc att ccc gca acc ttc | 643 |
| Ala Ala Val Leu Ala Tyr Ile Val His Lys Ala Ile Pro Ala Thr Phe | |
| 170 175 180 | |
| agc agg cct gga tca ctc gac atc ttc gga gca att acc tcc acg gca | 691 |
| Ser Arg Pro Gly Ser Leu Asp Ile Phe Gly Ala Ile Thr Ser Thr Ala | |
| 185 190 195 | |
| ggt atc gcc gcg gtg ctc tac gca att gtc cgc agc gcc gat tac agc | 739 |
| Gly Ile Ala Ala Val Leu Tyr Ala Ile Val Arg Ser Ala Asp Tyr Ser | |
| 200 205 210 | |
| tgg aca gat ccg ttt gtg ttg att tcc ctc gtg ctg ggc atc gca gtg | 787 |
| Trp Thr Asp Pro Phe Val Leu Ile Ser Leu Val Leu Gly Ile Ala Val | |
| 215 220 225 | |
| ttc atc tgg ttc ctg cgc cat gaa tcc tca gcc aaa gaa cca ctt ctg | 835 |
| Phe Ile Trp Phe Leu Arg His Glu Ser Ser Ala Lys Glu Pro Leu Leu | |
| 230 235 240 245 | |
| ccc ctg ggg ctc ttt aaa aac cgc agg cga aac acc atc ttg gcc agc | 883 |
| Pro Leu Gly Leu Phe Lys Asn Arg Arg Arg Asn Thr Ile Leu Ala Ser | |
| 250 255 260 | |
| cgc ttt ctt ctg gtt ggc tcc gtg atg tca ttc ttc ttc ttt gcc acc | 931 |
| Arg Phe Leu Leu Val Gly Ser Val Met Ser Phe Phe Phe Phe Ala Thr | |
| 265 270 275 | |
| cag ctg ttc cag gac acc atg gga atg aat gct ctc cag gca ggc ctt | 979 |
| Gln Leu Phe Gln Asp Thr Met Gly Met Asn Ala Leu Gln Ala Gly Leu | |
| 280 285 290 | |
| gcg ttc atg ccg cta tct ctg ctg cag ttt gcc agc gcc gcg atg gtg | 1027 |
| Ala Phe Met Pro Leu Ser Leu Leu Gln Phe Ala Ser Ala Ala Met Val | |
| 295 300 305 | |
| cca cgg ctt tcc cga gca ggc gta tct gat tcc atg ctc acc gtc atc | 1075 |
| Pro Arg Leu Ser Arg Ala Gly Val Ser Asp Ser Met Leu Thr Val Ile | |
| 310 315 320 325 | |
| ggt ttc gcc atc atg gtc atc ggc atg gca ggc ctc gca ttt gta cca | 1123 |

Gly Phe Ala Ile Met Val Ile Gly Met Ala Gly Leu Ala Phe Val Pro
 330 335 340
 aac acg atg atc gcg ctg atc cta cca ata gtt ttg gtg gga ttt ggc 1171
 Asn Thr Met Ile Ala Leu Ile Leu Pro Ile Val Leu Val Gly Phe Gly
 345 350 355
 caa ggc ttc gct ttc gga cca atg aca gct ctg gca gtt caa ggt gca 1219
 Gln Gly Phe Ala Phe Gly Pro Met Thr Ala Leu Ala Val Gln Gly Ala
 360 365 370
 ccg aag gac caa tcc ggc gcc gtt tct ggc ctg gtg aat tcc ctt cac 1267
 Pro Lys Asp Gln Ser Gly Ala Val Ser Gly Leu Val Asn Ser Leu His
 375 380 385
 caa atc ggc ggc acc ttc ggt ttg ggt gtg ttc tcc tcc ttg gct gtc 1315
 Gln Ile Gly Gly Thr Phe Gly Leu Gly Val Phe Ser Ser Leu Ala Val
 390 395 400 405
 gct gtc atc gga cat gat gca aca tca gag atg atc agc gac cgc gca 1363
 Ala Val Ile Gly His Asp Ala Thr Ser Glu Met Ile Ser Asp Arg Ala
 410 415 420
 cac ttc gga ttc ttg ctc tcc acc gtg acg ctg acg ctg gcc acc atc 1411
 His Phe Gly Phe Leu Leu Ser Thr Val Thr Leu Thr Leu Ala Thr Ile
 425 430 435
 ttt gcg gtc aca ctg ctg aag cgc cac gaa acc cga aag agt agc gag 1459
 Phe Ala Val Thr Leu Leu Lys Arg His Glu Thr Arg Lys Ser Ser Glu
 440 445 450
 cgc cca acc cag ctc gtc gac gaa aag gca gtt acc tct tagtgcgctg 1508
 Arg Pro Thr Gln Leu Val Asp Glu Lys Ala Val Thr Ser
 455 460 465
 cagcatccca gtt 1521

 <210> 236
 <211> 466
 <212> PRT
 <213> Corynebacterium glutamicum

 <400> 236
 Met Ile Leu Ser Ile Val Leu Leu Gly Tyr Phe Met Ile Leu Leu Asp
 1 5 10 15
 Thr Ser Ile Val Ile Thr Gly Leu Pro Ala Ile Gly Ser Glu Leu Gly
 20 25 30
 Ile Asp Pro Val His Leu Ser Trp Val Gln Ser Ser Tyr Thr Leu Val
 35 40 45
 Phe Gly Ala Leu Leu Leu Leu Gly Ala Arg Ala Gly Asp Ile Phe Gly
 50 55 60
 Arg Lys Lys Val Leu Tyr Ile Gly Leu Ala Leu Phe Ala Ala Ser Ser

| | | | |
|-----------------|---------------------|-------------------------|-----------------|
| 65 | 70 | 75 | 80 |
| Leu Ala Ile Ala | Leu Ser Pro Asn Ala | Ala Val Leu Ile Gly Ala | Arg |
| | 85 | 90 | 95 |
| Val Val Gln Gly | Ala Gly Ala Ala | Ile Ile Ala Pro Ala | Thr Leu Ala |
| | 100 | 105 | 110 |
| Leu Ile Thr Glu | Phe Phe Pro Glu Gly | Pro Ala Arg Leu Arg | Ala Thr |
| | 115 | 120 | 125 |
| Ser Ala Tyr Gly | Ala Val Ala Gly | Ile Gly Val Ala Ala | Gly Leu Val |
| | 130 | 135 | 140 |
| Ile Gly Gly Val | Phe Ala Asp Leu Leu | Ser Trp Arg Ile Gly | Phe Phe |
| | 145 | 150 | 155 |
| Ile Asn Val Pro | Ile Ala Ala Val | Leu Ala Tyr Ile | Val His Lys Ala |
| | 165 | 170 | 175 |
| Ile Pro Ala Thr | Phe Ser Arg Pro | Gly Ser Leu Asp | Ile Phe Gly Ala |
| | 180 | 185 | 190 |
| Ile Thr Ser Thr | Ala Gly Ile Ala | Ala Val Leu Tyr | Ala Ile Val Arg |
| | 195 | 200 | 205 |
| Ser Ala Asp Tyr | Ser Trp Thr Asp | Pro Phe Val Leu | Ile Ser Leu Val |
| | 210 | 215 | 220 |
| Leu Gly Ile Ala | Val Phe Ile Trp | Phe Leu Arg His | Glu Ser Ser Ala |
| | 225 | 230 | 235 |
| Lys Glu Pro Leu | Leu Pro Leu Gly | Leu Phe Lys Asn | Arg Arg Arg Asn |
| | 245 | 250 | 255 |
| Thr Ile Leu Ala | Ser Arg Phe Leu | Leu Val Gly Ser | Val Met Ser Phe |
| | 260 | 265 | 270 |
| Phe Phe Phe Ala | Thr Gln Leu Phe | Gln Asp Thr Met | Gly Met Asn Ala |
| | 275 | 280 | 285 |
| Leu Gln Ala Gly | Leu Ala Phe Met | Pro Leu Ser Leu | Leu Gln Phe Ala |
| | 290 | 295 | 300 |
| Ser Ala Ala Met | Val Pro Arg Leu | Ser Arg Ala Gly | Val Ser Asp Ser |
| | 305 | 310 | 315 |
| Met Leu Thr Val | Ile Gly Phe Ala | Ile Met Val Ile | Gly Met Ala Gly |
| | 325 | 330 | 335 |
| Leu Ala Phe Val | Pro Asn Thr Met | Ile Ala Leu Ile | Leu Pro Ile Val |
| | 340 | 345 | 350 |
| Leu Val Gly Phe | Gly Gln Gly Phe | Ala Phe Gly Pro | Met Thr Ala Leu |
| | 355 | 360 | 365 |
| Ala Val Gln Gly | Ala Pro Lys Asp | Gln Ser Gly Ala | Val Ser Gly Leu |

370 375 380
 Val Asn Ser Leu His Gln Ile Gly Gly Thr Phe Gly Leu Gly Val Phe
 385 390 395 400
 Ser Ser Leu Ala Val Ala Val Ile Gly His Asp Ala Thr Ser Glu Met
 405 410 415
 Ile Ser Asp Arg Ala His Phe Gly Phe Leu Leu Ser Thr Val Thr Leu
 420 425 430
 Thr Leu Ala Thr Ile Phe Ala Val Thr Leu Leu Lys Arg His Glu Thr
 435 440 445
 Arg Lys Ser Ser Glu Arg Pro Thr Gln Leu Val Asp Glu Lys Ala Val
 450 455 460
 Thr Ser
 465

 <210> 237
 <211> 1584
 <212> DNA
 <213> Corynebacterium glutamicum

 <220>
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 <222> (101)..(1561)
 <223> RXA00215

 <400> 237
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 ccttttccag gcgcccctcgt gcgtgaaaga ataactcaac gtg tct gac aaa aag 115
 Val Ser Asp Lys Lys
 1 5
 cag gat cta aca tcc tcc gca gca ggt agt gct gca ccc caa acc aag 163
 Gln Asp Leu Thr Ser Ser Ala Ala Gly Ser Ala Ala Pro Gln Thr Lys
 10 15 20
 gcc tac ccc gcc atg ccc ttg cct gaa aag caa gct tgg cca gct cta 211
 Ala Tyr Pro Ala Met Pro Leu Pro Glu Lys Gln Ala Trp Pro Ala Leu
 25 30 35
 att gcc ttg tgc att ggg ttt ttc atg atc ctg ttg gat caa acc atc 259
 Ile Ala Leu Cys Ile Gly Phe Phe Met Ile Leu Leu Asp Gln Thr Ile
 40 45 50
 gtg gcc gtc tct acc cca gcg tta cag gca gac atg ggc gcg tcc tac 307
 Val Ala Val Ser Thr Pro Ala Leu Gln Ala Asp Met Gly Ala Ser Tyr
 55 60 65
 aac gag gtc atc tgg gta acc tcg gtg tat ctc ctc act ttc gcg gtg 355
 Asn Glu Val Ile Trp Val Thr Ser Val Tyr Leu Leu Thr Phe Ala Val
 70 75 80 85

| | |
|---|------|
| cca ctg ctt gtt act ggc cgt ttg ggc gac aag tac ggt ccg aaa aat | 403 |
| Pro Leu Leu Val Thr Gly Arg Leu Gly Asp Lys Tyr Gly Pro Lys Asn | |
| 90 95 100 | |
| gtc tat gtc gca ggc atg gtt atc ttc aca gtg agc tct ttg gcc tgt | 451 |
| Val Tyr Val Ala Gly Met Val Ile Phe Thr Val Ser Ser Leu Ala Cys | |
| 105 110 115 | |
| ggg ttg gcc cca gac atg ttc acg ttg att atc gct cgt ggc gtt caa | 499 |
| Gly Leu Ala Pro Asp Met Phe Thr Leu Ile Ile Ala Arg Gly Val Gln | |
| 120 125 130 | |
| ggg ttg ggc gca gcc ctt ttg act cca caa acc atg gca aca atc aac | 547 |
| Gly Leu Gly Ala Ala Leu Leu Thr Pro Gln Thr Met Ala Thr Ile Asn | |
| 135 140 145 | |
| cgc atc ttt gct ttt gag cgc cgc ggt gca gct ctt gga gtg tgg ggt | 595 |
| Arg Ile Phe Ala Phe Glu Arg Arg Gly Ala Ala Leu Gly Val Trp Gly | |
| 150 155 160 165 | |
| tct aca gct ggc ctt gca tcc cta gca gga ccg atc ctg ggt ggt gtc | 643 |
| Ser Thr Ala Gly Leu Ala Ser Leu Ala Gly Pro Ile Leu Gly Gly Val | |
| 170 175 180 | |
| atc acc gaa aac tgg ggt tgg caa tgg gtc ttc tac atc aac gtg ccc | 691 |
| Ile Thr Glu Asn Trp Gly Trp Gln Trp Val Phe Tyr Ile Asn Val Pro | |
| 185 190 195 | |
| atc ggc gtg atc tcg gtg atc gca gta atg aag tac gtt cct gaa ttc | 739 |
| Ile Gly Val Ile Ser Val Ile Ala Val Met Lys Tyr Val Pro Glu Phe | |
| 200 205 210 | |
| cca ccg ctg acc cga ccg ctt gat ccg ctt tct atc gtg ttg tcc atc | 787 |
| Pro Pro Leu Thr Arg Pro Leu Asp Pro Leu Ser Ile Val Leu Ser Ile | |
| 215 220 225 | |
| gtg gcc gtg ttc ttc ctg gtg ttt gct ttc cag gaa ggc gaa ggc gct | 835 |
| Val Ala Val Phe Phe Leu Val Phe Ala Phe Gln Glu Gly Glu Gly Ala | |
| 230 235 240 245 | |
| ggc tgg gcg gca tgg gtg tgg atc atg atc gta gcc gcc ttt gcg ctc | 883 |
| Gly Trp Ala Ala Trp Val Trp Ile Met Ile Val Ala Ala Phe Ala Leu | |
| 250 255 260 | |
| ttt gcg tgg ttt atc tac caa caa agc agg gcc gag aaa tcc gga aac | 931 |
| Phe Ala Trp Phe Ile Tyr Gln Gln Ser Arg Ala Glu Lys Ser Gly Asn | |
| 265 270 275 | |
| gat cct ctc gtc cca ctg gag att ttc aag ttt aga aac ttc agc ctc | 979 |
| Asp Pro Leu Val Pro Leu Glu Ile Phe Lys Phe Arg Asn Phe Ser Leu | |
| 280 285 290 | |
| ggc aat atc tgc atc atg gcc atg gga ttc acc gtg gct ggt act cct | 1027 |
| Gly Asn Ile Cys Ile Met Ala Met Gly Phe Thr Val Ala Gly Thr Pro | |
| 295 300 305 | |

ctg ccc atc atg ttg tac ttc cag caa gca cac gga atg aac gcc atg 1075
 Leu Pro Ile Met Leu Tyr Phe Gln Gln Ala His Gly Met Asn Ala Met
 310 315 320 325

gaa gcg ggt ttc atg atg gtg cct caa gct ctc atg gca gca gta ctg 1123
 Glu Ala Gly Phe Met Met Val Pro Gln Ala Leu Met Ala Ala Val Leu
 330 335 340

tca cca ttt gtt gga aag ctg gtt gat cga tcc aac cct gga ctc atg 1171
 Ser Pro Phe Val Gly Lys Leu Val Asp Arg Ser Asn Pro Gly Leu Met
 345 350 355

gca gcc ctc ggt ttt agc aca gtg gct gtg tcc att gta ctg ctg tca 1219
 Ala Ala Leu Gly Phe Ser Thr Val Ala Val Ser Ile Val Leu Leu Ser
 360 365 370

atg gta atg att ttc gat acg ggt cta gtc tgg gca ctt gtt tcg atg 1267
 Met Val Met Ile Phe Asp Thr Gly Leu Val Trp Ala Leu Val Ser Met
 375 380 385

act ttg ctc ggc atc gga aac gcc ttt gtg tgg gca ccg aac tcg acc 1315
 Thr Leu Leu Gly Ile Gly Asn Ala Phe Val Trp Ala Pro Asn Ser Thr
 390 395 400 405

tcc act atg cgc gac ctg cca cac aag ttc atg gga gcg ggc tct ggc 1363
 Ser Thr Met Arg Asp Leu Pro His Lys Phe Met Gly Ala Gly Ser Gly
 410 415 420

gtg ttc aat aca acc cgc caa tta ggt tca gtc atc ggc gcc gct gcc 1411
 Val Phe Asn Thr Thr Arg Gln Leu Gly Ser Val Ile Gly Ala Ala Ala
 425 430 435

atc ggc gcg gta atg cag att cga ctg gca gca ggc gat gag ggc gca 1459
 Ile Gly Ala Val Met Gln Ile Arg Leu Ala Ala Gly Asp Glu Gly Ala
 440 445 450

gct ttt ggt caa gca ctt cta ctt gcc gct gcg gtg ctg gtt atc ggc 1507
 Ala Phe Gly Gln Ala Leu Leu Leu Ala Ala Val Leu Val Ile Gly
 455 460 465

att gtg gca tca acg atg gca gga aaa aat gca cac cca gcg ccg gta 1555
 Ile Val Ala Ser Thr Met Ala Gly Lys Asn Ala His Pro Ala Pro Val
 470 475 480 485

aag cct taaaggctcgc atgaatcctt cga 1584
 Lys Pro

<210> 238
 <211> 487
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 238
 Val Ser Asp Lys Lys Gln Asp Leu Thr Ser Ser Ala Ala Gly Ser Ala
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Ala Pro Gln Thr Lys Ala Tyr Pro Ala Met Pro Leu Pro Glu Lys Gln
 20 25 30
 Ala Trp Pro Ala Leu Ile Ala Leu Cys Ile Gly Phe Phe Met Ile Leu
 35 40 45
 Leu Asp Gln Thr Ile Val Ala Val Ser Thr Pro Ala Leu Gln Ala Asp
 50 55 60
 Met Gly Ala Ser Tyr Asn Glu Val Ile Trp Val Thr Ser Val Tyr Leu
 65 70 75 80
 Leu Thr Phe Ala Val Pro Leu Leu Val Thr Gly Arg Leu Gly Asp Lys
 85 90 95
 Tyr Gly Pro Lys Asn Val Tyr Val Ala Gly Met Val Ile Phe Thr Val
 100 105 110
 Ser Ser Leu Ala Cys Gly Leu Ala Pro Asp Met Phe Thr Leu Ile Ile
 115 120 125
 Ala Arg Gly Val Gln Gly Leu Gly Ala Ala Leu Leu Thr Pro Gln Thr
 130 135 140
 Met Ala Thr Ile Asn Arg Ile Phe Ala Phe Glu Arg Arg Gly Ala Ala
 145 150 155 160
 Leu Gly Val Trp Gly Ser Thr Ala Gly Leu Ala Ser Leu Ala Gly Pro
 165 170 175
 Ile Leu Gly Gly Val Ile Thr Glu Asn Trp Gly Trp Gln Trp Val Phe
 180 185 190
 Tyr Ile Asn Val Pro Ile Gly Val Ile Ser Val Ile Ala Val Met Lys
 195 200 205
 Tyr Val Pro Glu Phe Pro Pro Leu Thr Arg Pro Leu Asp Pro Leu Ser
 210 215 220
 Ile Val Leu Ser Ile Val Ala Val Phe Phe Leu Val Phe Ala Phe Gln
 225 230 235 240
 Glu Gly Glu Gly Ala Gly Trp Ala Ala Trp Val Trp Ile Met Ile Val
 245 250 255
 Ala Ala Phe Ala Leu Phe Ala Trp Phe Ile Tyr Gln Gln Ser Arg Ala
 260 265 270
 Glu Lys Ser Gly Asn Asp Pro Leu Val Pro Leu Glu Ile Phe Lys Phe
 275 280 285
 Arg Asn Phe Ser Leu Gly Asn Ile Cys Ile Met Ala Met Gly Phe Thr
 290 295 300
 Val Ala Gly Thr Pro Leu Pro Ile Met Leu Tyr Phe Gln Gln Ala His
 305 310 315 320

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<210> 239
<211> 1455
<212> DNA
<213> Corynebacterium glutamicum
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<220>  
<221> CDS  
<222> (101)..(1432)  
<223> RXN03064
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<400> 239
tggagccttg tcttcctcca gcaatcccac aacggagcag gttgggatcc cgagaaatgt 60

tgtcatcatc ttggctgtat tagtttttac agcctttgtc atg atg ttg aat gag 115
                                         Met Met Leu Asn Glu
                                         1                               5

act act ctg gca gtc gcg ttg ccg tcg atc atg gcg gac ttt gac att 163
Thr Thr Leu Ala Val Ala Leu Pro Ser Ile Met Ala Asp Phe Asp Ile
                        10                               15                               20

gag gcg aat act gcg cag tgg ttg ctc act ggt ttt atg ttg acc atg 211

```

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Glu | Ala | Asn | Thr | Ala | Gln | Trp | Leu | Leu | Thr | Gly | Phe | Met | Leu | Thr | Met | | |
| | | | 25 | | | | | 30 | | | | | | 35 | | | |
| gct | gtg | gtt | ctt | cca | gct | act | ggg | tgg | atg | ttg | gaa | cgt | ttt | acc | act | 259 | |
| Ala | Val | Val | Leu | Pro | Ala | Thr | Gly | Trp | Met | Leu | Glu | Arg | Phe | Thr | Thr | | |
| | | 40 | | | | | 45 | | | | | 50 | | | | | |
| cgt | agt | gtg | ttt | att | ttc | gcc | acg | gtg | gtc | ttc | ctg | atc | ggg | act | gtg | 307 | |
| Arg | Ser | Val | Phe | Ile | Phe | Ala | Thr | Val | Val | Phe | Leu | Ile | Gly | Thr | Val | | |
| | 55 | | | | | 60 | | | | 65 | | | | | | | |
| acg | gct | gcg | ttg | tct | cct | act | ttt | gcg | att | atg | ctt | gca | gcc | cgc | gtc | 355 | |
| Thr | Ala | Ala | Leu | Ser | Pro | Thr | Phe | Ala | Ile | Met | Leu | Ala | Ala | Arg | Val | | |
| | 70 | | | | 75 | | | | | 80 | | | | | 85 | | |
| gct | cag | gcg | att | ggg | acc | gct | gtg | atc | atg | ccg | ctg | ctg | atg | act | gtc | 403 | |
| Ala | Gln | Ala | Ile | Gly | Thr | Ala | Val | Ile | Met | Pro | Leu | Leu | Met | Thr | Val | | |
| | | | 90 | | | | | 95 | | | | | | 100 | | | |
| gcg | atg | acc | gtt | gtt | cct | cca | gag | cgc | cgt | ggc | gcc | gtc | atg | ggg | ttg | 451 | |
| Ala | Met | Thr | Val | Val | Pro | Pro | Glu | Arg | Arg | Gly | Ala | Val | Met | Gly | Leu | | |
| | | | 105 | | | | | 110 | | | | | 115 | | | | |
| att | gcg | gtc | gtg | atg | gcc | gtt | ggg | cct | gct | ctt | gga | cct | agt | gtg | gct | 499 | |
| Ile | Ala | Val | Val | Met | Ala | Val | Gly | Pro | Ala | Leu | Gly | Pro | Ser | Val | Ala | | |
| | | 120 | | | | | 125 | | | | | 130 | | | | | |
| ggg | ttc | gta | ctc | agc | ttg | tct | tcg | tgg | cac | gcg | att | ttc | tgg | gtc | atg | 547 | |
| Gly | Phe | Val | Leu | Ser | Leu | Ser | Ser | Trp | His | Ala | Ile | Phe | Trp | Val | Met | | |
| | | 135 | | | | | 140 | | | | | 145 | | | | | |
| gtt | ccg | ttg | gtg | ttt | gtg | gca | agc | ctg | atc | ggg | acc | ctg | cgt | ctg | acc | 595 | |
| Val | Pro | Leu | Val | Phe | Val | Ala | Ser | Leu | Ile | Gly | Thr | Leu | Arg | Leu | Thr | | |
| | 150 | | | | | 155 | | | | 160 | | | | | 165 | | |
| aac | gtc | agt | gag | cct | aaa | aag | act | cct | ttg | gat | gtt | att | tcc | ttc | ctg | 643 | |
| Asn | Val | Ser | Glu | Pro | Lys | Lys | Thr | Pro | Leu | Asp | Val | Ile | Ser | Phe | Leu | | |
| | | | | 170 | | | | | 175 | | | | | 180 | | | |
| att | tcc | gca | gtg | gct | ttc | ggg | ggc | ctt | gtg | tac | gcc | ttg | agc | tcg | att | 691 | |
| Ile | Ser | Ala | Val | Ala | Phe | Gly | Gly | Leu | Val | Tyr | Ala | Leu | Ser | Ser | Ile | | |
| | | 185 | | | | | | 190 | | | | | 195 | | | | |
| ggc | atc | att | ttg | gaa | ggg | gac | aga | agc | gct | ttg | gtc | gtg | ttg | gct | gtc | 739 | |
| Gly | Ile | Ile | Leu | Glu | Gly | Asp | Arg | Ser | Ala | Leu | Val | Val | Leu | Ala | Val | | |
| | | 200 | | | | | 205 | | | | | 210 | | | | | |
| ggc | atc | att | gcg | ttg | gtg | gtg | ttt | gtg | tgg | cgc | cag | att | gcc | atg | ggg | 787 | |
| Gly | Ile | Ile | Ala | Leu | Val | Val | Phe | Val | Trp | Arg | Gln | Ile | Ala | Met | Gly | | |
| | | 215 | | | | | 220 | | | | 225 | | | | | | |
| aag | cag | gat | aag | gcg | ctg | ttg | gat | ctg | cgt | ccg | ttg | gcg | att | cgt | gag | 835 | |
| Lys | Gln | Asp | Lys | Ala | Leu | Leu | Asp | Leu | Arg | Pro | Leu | Ala | Ile | Arg | Glu | | |
| | 230 | | | | 235 | | | | | 240 | | | | 245 | | | |
| tac | acc | att | ccg | ctg | gtt | gtg | ctt | ttg | acg | ctg | ttc | ggg | gcg | ctg | ctc | 883 | |
| Tyr | Thr | Ile | Pro | Leu | Val | Val | Leu | Leu | Thr | Leu | Phe | Gly | Ala | Leu | Leu | | |

| 250 | 255 | 260 | |
|---|-----|-----|------|
| ggt gtc atg aat aca ctg ccg ctc tac ctg cag gga tcc ttg atg gtc Gly Val Met Asn Thr Leu Pro Leu Tyr Leu Gln Gly Ser Leu Met Val 265 270 275 | | | 931 |
| acc gcc ttg gtc gcg ggt cta gtg ctg ttg cca ggt ggt ctt ttg gaa Thr Ala Leu Val Ala Gly Leu Val Leu Leu Pro Gly Gly Leu Leu Glu 280 285 290 | | | 979 |
| ggt gtg ctg tcg cca ttt gtg ggt cga att tat gat cgt cat ggt cca Gly Val Leu Ser Pro Phe Val Gly Arg Ile Tyr Asp Arg His Gly Pro 295 300 305 | | | 1027 |
| cgc gga ctc gtg atc ggc ggt atg tca ctc gtt gtg atc tcc ctg ttt Arg Gly Leu Val Ile Gly Gly Met Ser Leu Val Val Ile Ser Leu Phe 310 315 320 325 | | | 1075 |
| gca ctg tcc acc gtc gat gag ttc gcc aac gtg tgg ttc atc atc ggc Ala Leu Ser Thr Val Asp Glu Phe Ala Asn Val Trp Phe Ile Ile Gly 330 335 340 | | | 1123 |
| gta cac atc gtg ttc tcc atc ggc ctt gcg ctg ctg ttc acc cca ctg Val His Ile Val Phe Ser Ile Gly Leu Ala Leu Leu Phe Thr Pro Leu 345 350 355 | | | 1171 |
| atg aca gtc gcg ctc gca tcc gtc ccc gac aac atg tac ggc cac ggc Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn Met Tyr Gly His Gly 360 365 370 | | | 1219 |
| tcc gcg atc ctc aac acc ctc caa cag ctc gcc ggc gcc gca ggc acc Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala Gly Ala Ala Gly Thr 375 380 385 | | | 1267 |
| gcg gtc atg att gcg gtt tat tcc acc gtc agc aac aac gcg ctt atc Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser Asn Asn Ala Leu Ile 390 395 400 405 | | | 1315 |
| gac ggc gca acc caa caa acc gcc ctc gcc gac ggc gcc aac tct gca Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp Gly Ala Asn Ser Ala 410 415 420 | | | 1363 |
| ttc ttc gcc tca gcg tgc gtg gca gtg ttt gca ctg atc gtg ggc ttc Phe Phe Ala Ser Ala Cys Val Ala Val Phe Ala Leu Ile Val Gly Phe 425 430 435 | | | 1411 |
| ttt gta aag agg cca gcc cgc taagctaggt cgcatgatca gca Phe Val Lys Arg Pro Ala Arg 440 | | | 1455 |

<210> 240

<211> 444

<212> PRT

<213> Corynebacterium glutamicum

<400> 240

Met Met Leu Asn Glu Thr Thr Leu Ala Val Ala Leu Pro Ser Ile Met
 1 5 10 15
 Ala Asp Phe Asp Ile Glu Ala Asn Thr Ala Gln Trp Leu Leu Thr Gly
 20 25 30
 Phe Met Leu Thr Met Ala Val Val Leu Pro Ala Thr Gly Trp Met Leu
 35 40 45
 Glu Arg Phe Thr Thr Arg Ser Val Phe Ile Phe Ala Thr Val Val Phe
 50 55 60
 Leu Ile Gly Thr Val Thr Ala Ala Leu Ser Pro Thr Phe Ala Ile Met
 65 70 75 80
 Leu Ala Ala Arg Val Ala Gln Ala Ile Gly Thr Ala Val Ile Met Pro
 85 90 95
 Leu Leu Met Thr Val Ala Met Thr Val Val Pro Pro Glu Arg Arg Gly
 100 105 110
 Ala Val Met Gly Leu Ile Ala Val Val Met Ala Val Gly Pro Ala Leu
 115 120 125
 Gly Pro Ser Val Ala Gly Phe Val Leu Ser Leu Ser Ser Trp His Ala
 130 135 140
 Ile Phe Trp Val Met Val Pro Leu Val Phe Val Ala Ser Leu Ile Gly
 145 150 155 160
 Thr Leu Arg Leu Thr Asn Val Ser Glu Pro Lys Lys Thr Pro Leu Asp
 165 170 175
 Val Ile Ser Phe Leu Ile Ser Ala Val Ala Phe Gly Gly Leu Val Tyr
 180 185 190
 Ala Leu Ser Ser Ile Gly Ile Ile Leu Glu Gly Asp Arg Ser Ala Leu
 195 200 205
 Val Val Leu Ala Val Gly Ile Ile Ala Leu Val Val Phe Val Trp Arg
 210 215 220
 Gln Ile Ala Met Gly Lys Gln Asp Lys Ala Leu Leu Asp Leu Arg Pro
 225 230 235 240
 Leu Ala Ile Arg Glu Tyr Thr Ile Pro Leu Val Val Leu Leu Thr Leu
 245 250 255
 Phe Gly Ala Leu Leu Gly Val Met Asn Thr Leu Pro Leu Tyr Leu Gln
 260 265 270
 Gly Ser Leu Met Val Thr Ala Leu Val Ala Gly Leu Val Leu Leu Pro
 275 280 285
 Gly Gly Leu Leu Glu Gly Val Leu Ser Pro Phe Val Gly Arg Ile Tyr
 290 295 300

Asp Arg His Gly Pro Arg Gly Leu Val Ile Gly Gly Met Ser Leu Val
305 310 315 320

Val Ile Ser Leu Phe Ala Leu Ser Thr Val Asp Glu Phe Ala Asn Val
325 330 335

Trp Phe Ile Ile Gly Val His Ile Val Phe Ser Ile Gly Leu Ala Leu
340 345 350

Leu Phe Thr Pro Leu Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn
355 360 365

Met Tyr Gly His Gly Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala
370 375 380

Gly Ala Ala Gly Thr Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser
385 390 395 400

Asn Asn Ala Leu Ile Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp
405 410 415

Gly Ala Asn Ser Ala Phe Phe Ala Ser Ala Cys Val Ala Val Phe Ala
420 425 430

Leu Ile Val Gly Phe Phe Val Lys Arg Pro Ala Arg
435 440

<210> 241
<211> 1093
<212> DNA
<213> Corynebacterium glutamicum

<220>
<221> CDS
<222> (101)..(1093)
<223> FRXA00565

<400> 241
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tgatcatcatc ttggctgtat tagttttttac agcctttgtc atg atg ttg aat gag 115
Met Met Leu Asn Glu
1 5
act act ctg gca gtc gcg ttg ccg tcg atc atg gcg gac ttt gac att 163
Thr Thr Leu Ala Val Ala Leu Pro Ser Ile Met Ala Asp Phe Asp Ile
10 15 20
gag gcg aat act gcg cag tgg ttg ctc act ggt ttt atg ttg acc atg 211
Glu Ala Asn Thr Ala Gln Trp Leu Leu Thr Gly Phe Met Leu Thr Met
25 30 35
gct gtg gtt ctt cca gct act ggt tgg atg ttg gaa cgt ttt acc act 259
Ala Val Val Leu Pro Ala Thr Gly Trp Met Leu Glu Arg Phe Thr Thr
40 45 50

| | |
|---|-----|
| cgt agt gtg ttt att ttc gcc acg gtg gtc ttc ctg atc ggt act gtg | 307 |
| Arg Ser Val Phe Ile Phe Ala Thr Val Val Phe Leu Ile Gly Thr Val | |
| 55 60 65 | |
| acg gct gcg ttg tct cct act ttt gcg att atg ctt gca gcc cgc gtc | 355 |
| Thr Ala Ala Leu Ser Pro Thr Phe Ala Ile Met Leu Ala Ala Arg Val | |
| 70 75 80 85 | |
| gct cag gcg att ggt acc gct gtg atc atg ccg ctg ctg atg act gtc | 403 |
| Ala Gln Ala Ile Gly Thr Ala Val Ile Met Pro Leu Leu Met Thr Val | |
| 90 95 100 | |
| gcg atg acc gtt gtt cct cca gag cgc cgt ggc gcc gtc atg ggt ttg | 451 |
| Ala Met Thr Val Val Pro Pro Glu Arg Arg Gly Ala Val Met Gly Leu | |
| 105 110 115 | |
| att gcg gtc gtg atg gcc gtt ggt cct gct ctt gga cct agt gtg gct | 499 |
| Ile Ala Val Val Met Ala Val Gly Pro Ala Leu Gly Pro Ser Val Ala | |
| 120 125 130 | |
| ggt ttc gta ctc agc ttg tct tcg tgg cac gcg att ttc tgg gtc atg | 547 |
| Gly Phe Val Leu Ser Leu Ser Ser Trp His Ala Ile Phe Trp Val Met | |
| 135 140 145 | |
| gtt ccg ttg gtg ttt gtg gca agc ctg atc ggt acc ctg cgt ctg acc | 595 |
| Val Pro Leu Val Phe Val Ala Ser Leu Ile Gly Thr Leu Arg Leu Thr | |
| 150 155 160 165 | |
| aac gtc agt gag cct aaa aag act cct ttg gat gtt att tcc ttc ctg | 643 |
| Asn Val Ser Glu Pro Lys Lys Thr Pro Leu Asp Val Ile Ser Phe Leu | |
| 170 175 180 | |
| att tcc gca gtg gct ttc ggt ggc ctt gtg tac gcc ttg agc tcg att | 691 |
| Ile Ser Ala Val Ala Phe Gly Gly Leu Val Tyr Ala Leu Ser Ser Ile | |
| 185 190 195 | |
| ggc atc att ttg gaa ggt gac aga agc gct ttg gtc gtg ttg gct gtc | 739 |
| Gly Ile Ile Leu Glu Gly Asp Arg Ser Ala Leu Val Val Leu Ala Val | |
| 200 205 210 | |
| ggc atc att gcg ttg gtg gtg ttt gtg tgg cgc cag att gcc atg ggt | 787 |
| Gly Ile Ile Ala Leu Val Val Phe Val Trp Arg Gln Ile Ala Met Gly | |
| 215 220 225 | |
| aag cag gat aag gcg ctg ttg gat ctg cgt ccg ttg gcg att cgt gag | 835 |
| Lys Gln Asp Lys Ala Leu Leu Asp Leu Arg Pro Leu Ala Ile Arg Glu | |
| 230 235 240 245 | |
| tac acc att ccg ctg gtt gtg ctt ttg acg ctg ttc ggt gcg ctg ctc | 883 |
| Tyr Thr Ile Pro Leu Val Val Leu Leu Thr Leu Phe Gly Ala Leu Leu | |
| 250 255 260 | |
| ggt gtc atg aat aca ctg ccg ctc tac ctg cag gga tcc ttg atg gtc | 931 |
| Gly Val Met Asn Thr Leu Pro Leu Tyr Leu Gln Gly Ser Leu Met Val | |
| 265 270 275 | |
| acc gcc ttg gtc gcg ggt cta gtg ctg ttg cca ggt ggt ctt ttg gaa | 979 |

Thr Ala Leu Val Ala Gly Leu Val Leu Leu Pro Gly Gly Leu Leu Glu
 280 285 290

ggt gtg ctg tcg cca ttt gtg ggt cga att tat gat cgt cat ggt cca 1027
 Gly Val Leu Ser Pro Phe Val Gly Arg Ile Tyr Asp Arg His Gly Pro
 295 300 305

cgc gga ctc gtg atc ggc ggt atg tca ctc gtt gtg atc tcc ctg ttt 1075
 Arg Gly Leu Val Ile Gly Gly Met Ser Leu Val Val Ile Ser Leu Phe
 310 315 320 325

gca ctg tcc acc gtc gat 1093
 Ala Leu Ser Thr Val Asp
 330

<210> 242

<211> 331

<212> PRT

<213> Corynebacterium glutamicum

<400> 242

Met Met Leu Asn Glu Thr Thr Leu Ala Val Ala Leu Pro Ser Ile Met
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Ala Asp Phe Asp Ile Glu Ala Asn Thr Ala Gln Trp Leu Leu Thr Gly
 20 25 30

Phe Met Leu Thr Met Ala Val Val Leu Pro Ala Thr Gly Trp Met Leu
 35 40 45

Glu Arg Phe Thr Thr Arg Ser Val Phe Ile Phe Ala Thr Val Val Phe
 50 55 60

Leu Ile Gly Thr Val Thr Ala Ala Leu Ser Pro Thr Phe Ala Ile Met
 65 70 75 80

Leu Ala Ala Arg Val Ala Gln Ala Ile Gly Thr Ala Val Ile Met Pro
 85 90 95

Leu Leu Met Thr Val Ala Met Thr Val Val Pro Pro Glu Arg Arg Gly
 100 105 110

Ala Val Met Gly Leu Ile Ala Val Val Met Ala Val Gly Pro Ala Leu
 115 120 125

Gly Pro Ser Val Ala Gly Phe Val Leu Ser Leu Ser Ser Trp His Ala
 130 135 140

Ile Phe Trp Val Met Val Pro Leu Val Phe Val Ala Ser Leu Ile Gly
 145 150 155 160

Thr Leu Arg Leu Thr Asn Val Ser Glu Pro Lys Lys Thr Pro Leu Asp
 165 170 175

Val Ile Ser Phe Leu Ile Ser Ala Val Ala Phe Gly Gly Leu Val Tyr
 180 185 190

Ala Leu Ser Ser Ile Gly Ile Ile Leu Glu Gly Asp Arg Ser Ala Leu
 195 200 205

Val Val Leu Ala Val Gly Ile Ile Ala Leu Val Val Phe Val Trp Arg
 210 215 220

Gln Ile Ala Met Gly Lys Gln Asp Lys Ala Leu Leu Asp Leu Arg Pro
 225 230 235 240

Leu Ala Ile Arg Glu Tyr Thr Ile Pro Leu Val Val Leu Leu Thr Leu
 245 250 255

Phe Gly Ala Leu Leu Gly Val Met Asn Thr Leu Pro Leu Tyr Leu Gln
 260 265 270

Gly Ser Leu Met Val Thr Ala Leu Val Ala Gly Leu Val Leu Leu Pro
 275 280 285

Gly Gly Leu Leu Glu Gly Val Leu Ser Pro Phe Val Gly Arg Ile Tyr
 290 295 300

Asp Arg His Gly Pro Arg Gly Leu Val Ile Gly Gly Met Ser Leu Val
 305 310 315 320

Val Ile Ser Leu Phe Ala Leu Ser Thr Val Asp
 325 330

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 <213> Corynebacterium glutamicum

<220>
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 <223> FRXA02878

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gac aca tcg tgg ttc tca tcg gcc ctt gcg ctg ctg ttc acc cca ctg 96
 Asp Thr Ser Trp Phe Ser Ser Ala Leu Ala Leu Phe Thr Pro Leu
 20 25 30

atg aca gtc gcg ctc gca tcc gtc ccc gac aac atg tac ggc cac ggc 144
 Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn Met Tyr Gly His Gly
 35 40 45

tcc gcg atc ctc aac acc ctc caa cag ctc gcc ggc gcc gca ggc acc 192
 Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala Gly Ala Ala Gly Thr
 50 55 60

gcg gtc atg att gcg gtt tat tcc acc gtc agc aac aac gcg ctt atc 240

Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser Asn Asn Ala Leu Ile
 65 70 75 80

gac ggc gca acc caa caa acc gcc ctc gcc gac ggc gcc aac tct gca 288
 Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp Gly Ala Asn Ser Ala
 85 90 95

ttc ttc gcc tca gcg tgc gtg gca gtg ttt gca ctg atc gtg ggc ttc 336
 Phe Phe Ala Ser Ala Cys Val Ala Val Phe Ala Leu Ile Val Gly Phe
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ttt gta aag agg cca gcc cgc taagctaggt cgc atgatca gca 380
 Phe Val Lys Arg Pro Ala Arg
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<210> 244

<211> 119

<212> PRT

<213> Corynebacterium glutamicum

<400> 244

Cys Leu Ser Thr Val Asp Glu Phe Ala Thr Cys Trp Ser Ser Phe Ala
 1 5 10 15

Asp Thr Ser Trp Phe Ser Ser Ala Leu Ala Leu Leu Phe Thr Pro Leu
 20 25 30

Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn Met Tyr Gly His Gly
 35 40 45

Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala Gly Ala Ala Gly Thr
 50 55 60

Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser Asn Asn Ala Leu Ile
 65 70 75 80

Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp Gly Ala Asn Ser Ala
 85 90 95

Phe Phe Ala Ser Ala Cys Val Ala Val Phe Ala Leu Ile Val Gly Phe
 100 105 110

Phe Val Lys Arg Pro Ala Arg
 115

<210> 245

<211> 1533

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(1510)

<223> RXA00648

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Val Val Thr Leu Ala
1 5
tca gct ggt atc act gtt tcc cta gcg cag acc ctg gtt att ccg atc 163
Ser Ala Gly Ile Thr Val Ser Leu Ala Gln Thr Leu Val Ile Pro Ile
10 15 20
att ggt cgg ttg ccc gag atc ttc aac acc acg gct gct aat gcc tct 211
Ile Gly Arg Leu Pro Glu Ile Phe Asn Thr Thr Ala Ala Asn Ala Ser
25 30 35
tgg atc att act gtg acg ctg ttg gtg ggc gca gtg gcg act cct gtg 259
Trp Ile Ile Thr Val Thr Leu Leu Val Gly Ala Val Ala Thr Pro Val
40 45 50
atg ggc agg ctt gca gat atg tac ggc aag aaa aag atg atg ctc atc 307
Met Gly Arg Leu Ala Asp Met Tyr Gly Lys Lys Lys Met Met Leu Ile
55 60 65
tca ctt gtc ccg ttc att ctt gga tca gtg atc tgc gct gtg tcg gtg 355
Ser Leu Val Pro Phe Ile Leu Gly Ser Val Ile Cys Ala Val Ser Val
70 75 80 85
gat ttg att ccg atg atc atc ggc cgt ggt ttt cag ggg ctt ggc tct 403
Asp Leu Ile Pro Met Ile Ile Gly Arg Gly Phe Gln Gly Leu Gly Ser
90 95 100
ggc ctg att cct ctt ggc att tct ctc atg cat gat ttg ttg ccc ccg 451
Gly Leu Ile Pro Leu Gly Ile Ser Leu Met His Asp Leu Leu Pro Arg
105 110 115
gag aaa gca ggg tct gcc att gct ttg atg agt tct tcc atg ggc att 499
Glu Lys Ala Gly Ser Ala Ile Ala Leu Met Ser Ser Ser Met Gly Ile
120 125 130
ggc ggt gca ctc ggt cta ccg ctg gct gct gct att gcc cag ttt gcg 547
Gly Gly Ala Leu Gly Leu Pro Leu Ala Ala Ala Ile Ala Gln Phe Ala
135 140 145
tcc tgg cgg gtg ctg ttc tgg ttc acc gct ctg gta gcg ctt aca gtt 595
Ser Trp Arg Val Leu Phe Trp Phe Thr Ala Leu Val Ala Leu Thr Val
150 155 160 165
ggc gcg gtc att tgg aag gcg att cct gct aga ccc agg atc gtg agg 643
Gly Ala Val Ile Trp Lys Ala Ile Pro Ala Arg Pro Arg Ile Val Arg
170 175 180
agt ggc ggc ttt gat tat ttc ggt gct ctc ggc ctt gca atg gga ctt 691
Ser Gly Gly Phe Asp Tyr Phe Gly Ala Leu Gly Leu Ala Met Gly Leu
185 190 195
atc gca ttg ttg ctc gcg gtg tcc aag gga tca gaa tgg ggc tgg aga 739
Ile Ala Leu Leu Leu Ala Val Ser Lys Gly Ser Glu Trp Gly Trp Arg

| 200 | 205 | 210 | |
|---|-----|-----|------|
| agt gcc ctg acc att ggg tta ttc gtg gca gcg ctg gtg att ttg gtg Ser Ala Leu Thr Ile Gly Leu Phe Val Ala Ala Leu Val Ile Leu Val 215 220 225 | | | 787 |
| ggt tgg ggc tgg ttc gaa acc cgc cag aaa tcc cct ttg att gat ctg Gly Trp Gly Trp Phe Glu Thr Arg Gln Lys Ser Pro Leu Ile Asp Leu 230 235 240 245 | | | 835 |
| cgc acc act att cgg gcg acc gtg ttg atg aca aat att gcg tcc atc Arg Thr Thr Ile Arg Ala Thr Val Leu Met Thr Asn Ile Ala Ser Ile 250 255 260 | | | 883 |
| ctc atc ggt ttc acc atg tat gga atg aat ctg atc ctg cct cag gtc Leu Ile Gly Phe Thr Met Tyr Gly Met Asn Leu Ile Leu Pro Gln Val 265 270 275 | | | 931 |
| atg cag ctg cct gta att ctg ggc tac ggt cta ggc cag agc atg ctt Met Gln Leu Pro Val Ile Leu Gly Tyr Gly Leu Gly Gln Ser Met Leu 280 285 290 | | | 979 |
| cag atg ggc atc tgg ctg atc ccg atg ggt cta ggc atg atg ttg att Gln Met Gly Ile Trp Leu Ile Pro Met Gly Leu Gly Met Met Leu Ile 295 300 305 | | | 1027 |
| tcg aat gca ggt gca gcc att agc gct gct cat ggt cct cgt gtg acg Ser Asn Ala Gly Ala Ala Ile Ser Ala Ala His Gly Pro Arg Val Thr 310 315 320 325 | | | 1075 |
| ctg aca att gcg ggt gtt gtg atc gca gtc ggt tat gca ctt act gcc Leu Thr Ile Ala Gly Val Val Ile Ala Val Gly Tyr Ala Leu Thr Ala 330 335 340 | | | 1123 |
| aca gtg ttg ttc act atc ggc aac cgc aca ccg gga gga gat gca gac Thr Val Leu Phe Thr Ile Gly Asn Arg Thr Pro Gly Gly Asp Ala Asp 345 350 355 | | | 1171 |
| aac gca ctt att ttg acc acc ctg gtg ctg ttc tca gtg tgt agt ctc Asn Ala Leu Ile Leu Thr Thr Leu Val Leu Phe Ser Val Cys Ser Leu 360 365 370 | | | 1219 |
| gtg gtc ggt atc ggc att ggc ctg gca ttt ggt tcc atg cct gcc ttg Val Val Gly Ile Gly Ile Gly Leu Ala Phe Gly Ser Met Pro Ala Leu 375 380 385 | | | 1267 |
| atc atg ggt gcc gta cca gcc acg gag aaa gcc gca gcg aat ggt ttc Ile Met Gly Ala Val Pro Ala Thr Glu Lys Ala Ala Ala Asn Gly Phe 390 395 400 405 | | | 1315 |
| aac tct ctt atg cgt tca ctg ggc acc acc ggc tca tca gct gtc atc Asn Ser Leu Met Arg Ser Leu Gly Thr Thr Gly Ser Ser Ala Val Ile 410 415 420 | | | 1363 |
| ggt gca gtg ttg gcc gga atg atg agt ggc gga gta ccc acc tta ggg Gly Ala Val Leu Ala Gly Met Met Ser Gly Gly Val Pro Thr Leu Gly 425 430 435 | | | 1411 |

gga ttc atg acc act ctg atc atc gga tgc tgc gcc gcg ctt gtg gct 1459
 Gly Phe Met Thr Thr Leu Ile Ile Gly Cys Cys Ala Ala Leu Val Ala
 440 445 450

gcg gtc atc tcc tat ttc atc ccc acc aca acc act gtg gtg gaa gca 1507
 Ala Val Ile Ser Tyr Phe Ile Pro Thr Thr Thr Thr Val Val Glu Ala
 455 460 465

aaa taatcccggc agcgactcga cca 1533
 Lys
 470

<210> 246

<211> 470

<212> PRT

<213> Corynebacterium glutamicum

<400> 246

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Ala Ala Asn Ala Ser Trp Ile Ile Thr Val Thr Leu Leu Val Gly Ala
 35 40 45

Val Ala Thr Pro Val Met Gly Arg Leu Ala Asp Met Tyr Gly Lys Lys
 50 55 60

Lys Met Met Leu Ile Ser Leu Val Pro Phe Ile Leu Gly Ser Val Ile
 65 70 75 80

Cys Ala Val Ser Val Asp Leu Ile Pro Met Ile Ile Gly Arg Gly Phe
 85 90 95

Gln Gly Leu Gly Ser Gly Leu Ile Pro Leu Gly Ile Ser Leu Met His
 100 105 110

Asp Leu Leu Pro Arg Glu Lys Ala Gly Ser Ala Ile Ala Leu Met Ser
 115 120 125

Ser Ser Met Gly Ile Gly Gly Ala Leu Gly Leu Pro Leu Ala Ala Ala
 130 135 140

Ile Ala Gln Phe Ala Ser Trp Arg Val Leu Phe Trp Phe Thr Ala Leu
 145 150 155 160

Val Ala Leu Thr Val Gly Ala Val Ile Trp Lys Ala Ile Pro Ala Arg
 165 170 175

Pro Arg Ile Val Arg Ser Gly Gly Phe Asp Tyr Phe Gly Ala Leu Gly
 180 185 190

Leu Ala Met Gly Leu Ile Ala Leu Leu Leu Ala Val Ser Lys Gly Ser

| 195 | 200 | 205 |
|--|-----|-----|
| Glu Trp Gly Trp Arg Ser Ala Leu Thr Ile Gly Leu Phe Val Ala Ala 210 215 220 | | |
| Leu Val Ile Leu Val Gly Trp Gly Trp Phe Glu Thr Arg Gln Lys Ser 225 230 235 240 | | |
| Pro Leu Ile Asp Leu Arg Thr Thr Ile Arg Ala Thr Val Leu Met Thr 245 250 255 | | |
| Asn Ile Ala Ser Ile Leu Ile Gly Phe Thr Met Tyr Gly Met Asn Leu 260 265 270 | | |
| Ile Leu Pro Gln Val Met Gln Leu Pro Val Ile Leu Gly Tyr Gly Leu 275 280 285 | | |
| Gly Gln Ser Met Leu Gln Met Gly Ile Trp Leu Ile Pro Met Gly Leu 290 295 300 | | |
| Gly Met Met Leu Ile Ser Asn Ala Gly Ala Ala Ile Ser Ala Ala His 305 310 315 320 | | |
| Gly Pro Arg Val Thr Leu Thr Ile Ala Gly Val Val Ile Ala Val Gly 325 330 335 | | |
| Tyr Ala Leu Thr Ala Thr Val Leu Phe Thr Ile Gly Asn Arg Thr Pro 340 345 350 | | |
| Gly Gly Asp Ala Asp Asn Ala Leu Ile Leu Thr Thr Leu Val Leu Phe 355 360 365 | | |
| Ser Val Cys Ser Leu Val Val Gly Ile Gly Ile Gly Leu Ala Phe Gly 370 375 380 | | |
| Ser Met Pro Ala Leu Ile Met Gly Ala Val Pro Ala Thr Glu Lys Ala 385 390 395 400 | | |
| Ala Ala Asn Gly Phe Asn Ser Leu Met Arg Ser Leu Gly Thr Thr Gly 405 410 415 | | |
| Ser Ser Ala Val Ile Gly Ala Val Leu Ala Gly Met Met Ser Gly Gly 420 425 430 | | |
| Val Pro Thr Leu Gly Gly Phe Met Thr Thr Leu Ile Ile Gly Cys Cys 435 440 445 | | |
| Ala Ala Leu Val Ala Ala Val Ile Ser Tyr Phe Ile Pro Thr Thr Thr 450 455 460 | | |
| Thr Val Val Glu Ala Lys 465 470 | | |

<210> 247
 <211> 1770
 <212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1747)

<223> RXN01320

<400> 247

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caattaaaaa tacttttctt cttagagggtg gattttcaga atg aca tca cag gtc 115
                                   Met Thr Ser Gln Val
                                   1                               5

aag ccg gac gac gaa cgt ccg gta aca aca att tca aaa agt ggt gca 163
Lys Pro Asp Asp Glu Arg Pro Val Thr Thr Ile Ser Lys Ser Gly Ala
                                   10                               15                               20

cct tcg gcc cac acc tca gca cca tat ggt gca gca gca act gaa gaa 211
Pro Ser Ala His Thr Ser Ala Pro Tyr Gly Ala Ala Ala Thr Glu Glu
                                   25                               30                               35

gct gtc gag gaa aaa acc aaa ggt cgc gtt gga ttt atc atc gca gcc 259
Ala Val Glu Glu Lys Thr Lys Gly Arg Val Gly Phe Ile Ile Ala Ala
                                   40                               45                               50

ctc atg ttg gcg atg ctt ctt agc tcc ttg ggt cag acc att ttc ggt 307
Leu Met Leu Ala Met Leu Leu Ser Ser Leu Gly Gln Thr Ile Phe Gly
                                   55                               60                               65

tct gcc ctg cca acg att gtt ggt gag ctt ggc ggc gtt aac cac atg 355
Ser Ala Leu Pro Thr Ile Val Gly Glu Leu Gly Gly Val Asn His Met
                                   70                               75                               80                               85

acc tgg gtg att acc gcc ttc ctc ttg ggc cag acc att tca ttg cct 403
Thr Trp Val Ile Thr Ala Phe Leu Leu Gly Gln Thr Ile Ser Leu Pro
                                   90                               95                               100

att ttc ggc aag ttg ggt gac cag ttt ggt cgc aaa tac ctc ttc atg 451
Ile Phe Gly Lys Leu Gly Asp Gln Phe Gly Arg Lys Tyr Leu Phe Met
                                   105                               110                               115

ttt gcc atc gca ctg ttc gtg gtg ggt tcc atc atc ggt gct ttg gct 499
Phe Ala Ile Ala Leu Phe Val Val Gly Ser Ile Ile Gly Ala Leu Ala
                                   120                               125                               130

cag aac atg acc acc ttg att gtg gct cgt gca ctg cag ggt atc gcc 547
Gln Asn Met Thr Thr Leu Ile Val Ala Arg Ala Leu Gln Gly Ile Ala
                                   135                               140                               145

ggt ggt ggc ttg atg att ctt tct cag gca att acc gct gat gtc acc 595
Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile Thr Ala Asp Val Thr
                                   150                               155                               160                               165

acc gcc cgt gag cgt gca aag tac atg ggc atc atg ggt tcc gtt ttc 643
Thr Ala Arg Glu Arg Ala Lys Tyr Met Gly Ile Met Gly Ser Val Phe
                                   170                               175                               180

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| | |
|---|------|
| gga ctg tcc tcc atc ctt ggc cca ttg ctt ggt ggc tgg ttc act gac | 691 |
| Gly Leu Ser Ser Ile Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr Asp | |
| 185 190 195 | |
| ggt cca ggc tgg cgt tgg ggt ctg tgg ttg aac gtt cca atc ggc atc | 739 |
| Gly Pro Gly Trp Arg Trp Gly Leu Trp Leu Asn Val Pro Ile Gly Ile | |
| 200 205 210 | |
| atc gca ctg gtt gct atc gct gtg ctg ctg aaa ctt cca gct cgt gaa | 787 |
| Ile Ala Leu Val Ala Ile Ala Val Leu Leu Lys Leu Pro Ala Arg Glu | |
| 215 220 225 | |
| cgt ggc aag gtc tcc gtt gac tgg ttg gga agc atc ttc atg gct atc | 835 |
| Arg Gly Lys Val Ser Val Asp Trp Leu Gly Ser Ile Phe Met Ala Ile | |
| 230 235 240 245 | |
| gcc acc acc gca ttt gtc ctc gca gtg acc tgg ggt ggc aat gaa tat | 883 |
| Ala Thr Thr Ala Phe Val Leu Ala Val Thr Trp Gly Gly Asn Glu Tyr | |
| 250 255 260 | |
| gag tgg gca tca cca atg atc atc ggt ttg ttc atc acg aca ttg gtc | 931 |
| Glu Trp Ala Ser Pro Met Ile Ile Gly Leu Phe Ile Thr Thr Leu Val | |
| 265 270 275 | |
| gct gcg ata gtg ttc gtt ttc gtc gaa aag cgt gct gtt gac cca ctg | 979 |
| Ala Ala Ile Val Phe Val Phe Val Glu Lys Arg Ala Val Asp Pro Leu | |
| 280 285 290 | |
| gtc ccc atg ggc ctt ttc tcg aac cgc aac ttc gtg ctc acc gcc gtc | 1027 |
| Val Pro Met Gly Leu Phe Ser Asn Arg Asn Phe Val Leu Thr Ala Val | |
| 295 300 305 | |
| gcc ggt atc ggc gta ggc ctg ttt atg atg ggc acc atc gcg tac atg | 1075 |
| Ala Gly Ile Gly Val Gly Leu Phe Met Met Gly Thr Ile Ala Tyr Met | |
| 310 315 320 325 | |
| cct acc tac ctg cag atg gtt cat ggt ctg aac cca acg caa gct ggt | 1123 |
| Pro Thr Tyr Leu Gln Met Val His Gly Leu Asn Pro Thr Gln Ala Gly | |
| 330 335 340 | |
| ctg atg ctg atc cca atg atg atc ggc ctg att ggt aca tcc act gtg | 1171 |
| Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile Gly Thr Ser Thr Val | |
| 345 350 355 | |
| gtg ggc aac atc gtg tcc aag act ggc aag tac aag tgg tac cca ttc | 1219 |
| Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr Lys Trp Tyr Pro Phe | |
| 360 365 370 | |
| atc ggc atg ctc atc atg gtc ctt gcc cta gta ctg cta tcg acg ctg | 1267 |
| Ile Gly Met Leu Ile Met Val Leu Ala Leu Val Leu Leu Ser Thr Leu | |
| 375 380 385 | |
| aca cct tcg gca agc ttg gct ctc att gga ctg tac ttc ttc gtc ttc | 1315 |
| Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu Tyr Phe Phe Val Phe | |
| 390 395 400 405 | |

gga ttc ggc ctg ggc tgt gca atg cag att ttg gtt ctc atc gtg cag 1363
 Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu Val Leu Ile Val Gln
 410 415 420

aac tcc ttc cca atc acc atg gtt ggc acc gcg acc ggt tcc aac aac 1411
 Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala Thr Gly Ser Asn Asn
 425 430 435

ttc ttc cgc caa atc ggt gga gca gta ggt tcc gca ctg atc ggt ggc 1459
 Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser Ala Leu Ile Gly Gly
 440 445 450

ctg ttt atc tcc aac ctg tcc gac cga ttc acc gaa aac gtc ccc gca 1507
 Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr Glu Asn Val Pro Ala
 455 460 465

gca gtg gct tcc atg ggt gaa gaa ggc gca caa tac gcc tca gca atg 1555
 Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln Tyr Ala Ser Ala Met
 470 475 480 485

tcc gat ttc tcc ggt gca tcc aac ctc act cca cac ctt gtt gaa tca 1603
 Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro His Leu Val Glu Ser
 490 495 500

ctt cca caa gca ctc cgt gaa gca att caa ctt tct tac aac gac gcc 1651
 Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu Ser Tyr Asn Asp Ala
 505 510 515

ctg aca cca atc ttc ttg gcg ctc acc ccg atc gca gta gtc gcc gcg 1699
 Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile Ala Val Val Ala Ala
 520 525 530

atc ctc ctc ttt ttc atc cgt gaa gat cac ctc aag gaa acg cac gaa 1747
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 535 540 545

taatgacaca cgaaacttcc gtc 1770

<210> 248

<211> 549

<212> PRT

<213> Corynebacterium glutamicum

<400> 248

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Ala Ala Thr Glu Glu Ala Val Glu Glu Lys Thr Lys Gly Arg Val Gly
 35 40 45

Phe Ile Ile Ala Ala Leu Met Leu Ala Met Leu Leu Ser Ser Leu Gly
 50 55 60

Gln Thr Ile Phe Gly Ser Ala Leu Pro Thr Ile Val Gly Glu Leu Gly
 65 70 75 80
 Gly Val Asn His Met Thr Trp Val Ile Thr Ala Phe Leu Leu Gly Gln
 85 90 95
 Thr Ile Ser Leu Pro Ile Phe Gly Lys Leu Gly Asp Gln Phe Gly Arg
 100 105 110
 Lys Tyr Leu Phe Met Phe Ala Ile Ala Leu Phe Val Val Gly Ser Ile
 115 120 125
 Ile Gly Ala Leu Ala Gln Asn Met Thr Thr Leu Ile Val Ala Arg Ala
 130 135 140
 Leu Gln Gly Ile Ala Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile
 145 150 155 160
 Thr Ala Asp Val Thr Thr Ala Arg Glu Arg Ala Lys Tyr Met Gly Ile
 165 170 175
 Met Gly Ser Val Phe Gly Leu Ser Ser Ile Leu Gly Pro Leu Leu Gly
 180 185 190
 Gly Trp Phe Thr Asp Gly Pro Gly Trp Arg Trp Gly Leu Trp Leu Asn
 195 200 205
 Val Pro Ile Gly Ile Ile Ala Leu Val Ala Ile Ala Val Leu Leu Lys
 210 215 220
 Leu Pro Ala Arg Glu Arg Gly Lys Val Ser Val Asp Trp Leu Gly Ser
 225 230 235 240
 Ile Phe Met Ala Ile Ala Thr Thr Ala Phe Val Leu Ala Val Thr Trp
 245 250 255
 Gly Gly Asn Glu Tyr Glu Trp Ala Ser Pro Met Ile Ile Gly Leu Phe
 260 265 270
 Ile Thr Thr Leu Val Ala Ala Ile Val Phe Val Phe Val Glu Lys Arg
 275 280 285
 Ala Val Asp Pro Leu Val Pro Met Gly Leu Phe Ser Asn Arg Asn Phe
 290 295 300
 Val Leu Thr Ala Val Ala Gly Ile Gly Val Gly Leu Phe Met Met Gly
 305 310 315 320
 Thr Ile Ala Tyr Met Pro Thr Tyr Leu Gln Met Val His Gly Leu Asn
 325 330 335
 Pro Thr Gln Ala Gly Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile
 340 345 350
 Gly Thr Ser Thr Val Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr
 355 360 365

Lys Trp Tyr Pro Phe Ile Gly Met Leu Ile Met Val Leu Ala Leu Val
 370 375 380
 Leu Leu Ser Thr Leu Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu
 385 390 395 400
 Tyr Phe Phe Val Phe Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu
 405 410 415
 Val Leu Ile Val Gln Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala
 420 425 430
 Thr Gly Ser Asn Asn Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser
 435 440 445
 Ala Leu Ile Gly Gly Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr
 450 455 460
 Glu Asn Val Pro Ala Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln
 465 470 475 480
 Tyr Ala Ser Ala Met Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro
 485 490 495
 His Leu Val Glu Ser Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu
 500 505 510
 Ser Tyr Asn Asp Ala Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile
 515 520 525
 Ala Val Val Ala Ala Ile Leu Leu Phe Phe Ile Arg Glu Asp His Leu
 530 535 540
 Lys Glu Thr His Glu
 545

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 <211> 841
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(841)
 <223> FRXA01314

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 Met Thr Ser Gln Val
 1 5
 aag ccg gac gac gaa cgt ccg gta aca aca att tca aaa agt ggt gca 163
 Lys Pro Asp Asp Glu Arg Pro Val Thr Thr Ile Ser Lys Ser Gly Ala
 10 15 20

| | |
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| cct tcg gcc cac acc tca gca cca tat ggt gca gca gca act gaa gaa | 211 |
| Pro Ser Ala His Thr Ser Ala Pro Tyr Gly Ala Ala Ala Thr Glu Glu | |
| 25 30 35 | |
| gct gtc gag gaa aaa acc aaa ggt cgc gtt gga ttt atc atc gca gcc | 259 |
| Ala Val Glu Glu Lys Thr Lys Gly Arg Val Gly Phe Ile Ile Ala Ala | |
| 40 45 50 | |
| ctc atg ttg gcg atg ctt ctt agc tcc ttg ggt cag acc att ttc ggt | 307 |
| Leu Met Leu Ala Met Leu Leu Ser Ser Leu Gly Gln Thr Ile Phe Gly | |
| 55 60 65 | |
| tct gcc ctg cca acg att gtt ggt gag ctt ggc ggc gtt aac cac atg | 355 |
| Ser Ala Leu Pro Thr Ile Val Gly Glu Leu Gly Gly Val Asn His Met | |
| 70 75 80 85 | |
| acc tgg gtg att acc gcc ttc ctc ttg ggc cag acc att tca ttg cct | 403 |
| Thr Trp Val Ile Thr Ala Phe Leu Leu Gly Gln Thr Ile Ser Leu Pro | |
| 90 95 100 | |
| att ttc ggc aag ttg ggt gac cag ttt ggt cgc aaa tac ctc ttc atg | 451 |
| Ile Phe Gly Lys Leu Gly Asp Gln Phe Gly Arg Lys Tyr Leu Phe Met | |
| 105 110 115 | |
| ttt gcc atc gca ctg ttc gtg gtg ggt tcc atc atc ggt gct ttg gct | 499 |
| Phe Ala Ile Ala Leu Phe Val Val Gly Ser Ile Ile Gly Ala Leu Ala | |
| 120 125 130 | |
| cag aac atg acc acc ttg att gtg gct cgt gca ctg cag ggt atc gcc | 547 |
| Gln Asn Met Thr Thr Leu Ile Val Ala Arg Ala Leu Gln Gly Ile Ala | |
| 135 140 145 | |
| ggt ggt ggc ttg atg att ctt tct cag gca att acc gct gat gtc acc | 595 |
| Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile Thr Ala Asp Val Thr | |
| 150 155 160 165 | |
| acc gcc cgt gag cgt gca aag tac atg ggc atc atg ggt tcc gtt ttc | 643 |
| Thr Ala Arg Glu Arg Ala Lys Tyr Met Gly Ile Met Gly Ser Val Phe | |
| 170 175 180 | |
| gga ctg tcc tcc atc ctt ggc cca ttg ctt ggt ggc tgg ttc act gac | 691 |
| Gly Leu Ser Ser Ile Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr Asp | |
| 185 190 195 | |
| ggt cca ggc tgg cgt tgg ggt ctg tgg ttg aac gtt cca atc ggc atc | 739 |
| Gly Pro Gly Trp Arg Trp Gly Leu Trp Leu Asn Val Pro Ile Gly Ile | |
| 200 205 210 | |
| atc gca ctg gtt gct atc gct gtg ctg ctg aaa ctt cca gct cgt gaa | 787 |
| Ile Ala Leu Val Ala Ile Ala Val Leu Leu Lys Leu Pro Ala Arg Glu | |
| 215 220 225 | |
| cgt ggc aag gtc tcc gtt gac tgg ttg gga agc atc ttc atg gct atc | 835 |
| Arg Gly Lys Val Ser Val Asp Trp Leu Gly Ser Ile Phe Met Ala Ile | |
| 230 235 240 245 | |

gcc acc
Ala Thr

841

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<213> Corynebacterium glutamicum

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Ser Lys Ser Gly Ala Pro Ser Ala His Thr Ser Ala Pro Tyr Gly Ala
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Ala Ala Thr Glu Glu Ala Val Glu Glu Lys Thr Lys Gly Arg Val Gly
35 40 45
Phe Ile Ile Ala Ala Leu Met Leu Ala Met Leu Leu Ser Ser Leu Gly
50 55 60
Gln Thr Ile Phe Gly Ser Ala Leu Pro Thr Ile Val Gly Glu Leu Gly
65 70 75 80
Gly Val Asn His Met Thr Trp Val Ile Thr Ala Phe Leu Leu Gly Gln
85 90 95
Thr Ile Ser Leu Pro Ile Phe Gly Lys Leu Gly Asp Gln Phe Gly Arg
100 105 110
Lys Tyr Leu Phe Met Phe Ala Ile Ala Leu Phe Val Val Gly Ser Ile
115 120 125
Ile Gly Ala Leu Ala Gln Asn Met Thr Thr Leu Ile Val Ala Arg Ala
130 135 140
Leu Gln Gly Ile Ala Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile
145 150 155 160
Thr Ala Asp Val Thr Thr Ala Arg Glu Arg Ala Lys Tyr Met Gly Ile
165 170 175
Met Gly Ser Val Phe Gly Leu Ser Ser Ile Leu Gly Pro Leu Leu Gly
180 185 190
Gly Trp Phe Thr Asp Gly Pro Gly Trp Arg Trp Gly Leu Trp Leu Asn
195 200 205
Val Pro Ile Gly Ile Ile Ala Leu Val Ala Ile Ala Val Leu Leu Lys
210 215 220
Leu Pro Ala Arg Glu Arg Gly Lys Val Ser Val Asp Trp Leu Gly Ser
225 230 235 240
Ile Phe Met Ala Ile Ala Thr

245

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<220>
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 <222> (1)..(780)
 <223> FRXA01320

<400> 251

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| Val Asp Pro Leu Val Pro Met Gly Leu Phe Ser Asn Arg Asn Phe Val | |
| 1 5 10 15 | |
| ctc acc gcc gtc gcc ggt atc ggc gta ggc ctg ttt atg atg ggc acc | 96 |
| Leu Thr Ala Val Ala Gly Ile Gly Val Gly Leu Phe Met Met Gly Thr | |
| 20 25 30 | |
| atc gcg tac atg cct acc tac ctg cag atg gtt cat ggt ctg aac cca | 144 |
| Ile Ala Tyr Met Pro Thr Tyr Leu Gln Met Val His Gly Leu Asn Pro | |
| 35 40 45 | |
| acg caa gct ggt ctg atg ctg atc cca atg atg atc ggc ctg att ggt | 192 |
| Thr Gln Ala Gly Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile Gly | |
| 50 55 60 | |
| aca tcc act gtg gtg ggc aac atc gtg tcc aag act ggc aag tac aag | 240 |
| Thr Ser Thr Val Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr Lys | |
| 65 70 75 80 | |
| tgg tac cca ttc atc ggc atg ctc atc atg gtc ctt gcc cta gta ctg | 288 |
| Trp Tyr Pro Phe Ile Gly Met Leu Ile Met Val Leu Ala Leu Val Leu | |
| 85 90 95 | |
| cta tcg acg ctg aca cct tcg gca agc ttg gct ctc att gga ctg tac | 336 |
| Leu Ser Thr Leu Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu Tyr | |
| 100 105 110 | |
| ttc ttc gtc ttc gga ttc ggc ctg ggc tgt gca atg cag att ttg gtt | 384 |
| Phe Phe Val Phe Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu Val | |
| 115 120 125 | |
| ctc atc gtg cag aac tcc ttc cca atc acc atg gtt ggc acc gcg acc | 432 |
| Leu Ile Val Gln Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala Thr | |
| 130 135 140 | |
| ggt tcc aac aac ttc ttc cgc caa atc ggt gga gca gta ggt tcc gca | 480 |
| Gly Ser Asn Asn Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser Ala | |
| 145 150 155 160 | |
| ctg atc ggt ggc ctg ttt atc tcc aac ctg tcc gac cga ttc acc gaa | 528 |
| Leu Ile Gly Gly Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr Glu | |
| 165 170 175 | |

aac gtc ccc gca gca gtg gct tcc atg ggt gaa gaa ggc gca caa tac 576
 Asn Val Pro Ala Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln Tyr
 180 185 190

gcc tca gca atg tcc gat ttc tcc ggt gca tcc aac ctc act cca cac 624
 Ala Ser Ala Met Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro His
 195 200 205

ctt gtt gaa tca ctt cca caa gca ctc cgt gaa gca att caa ctt tct 672
 Leu Val Glu Ser Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu Ser
 210 215 220

tac aac gac gcc ctg aca cca atc ttc ttg gcg ctc acc ccg atc gca 720
 Tyr Asn Asp Ala Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile Ala
 225 230 235 240

gta gtc gcc gcg atc ctc ctc ttt ttc atc cgt gaa gat cac ctc aag 768
 Val Val Ala Ala Ile Leu Leu Phe Phe Ile Arg Glu Asp His Leu Lys
 245 250 255

gaa acg cac gaa taatgacaca cgaaacttcc gtc 803
 Glu Thr His Glu
 260

<210> 252
 <211> 260
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 252
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Leu Thr Ala Val Ala Gly Ile Gly Val Gly Leu Phe Met Met Gly Thr
 20 25 30

Ile Ala Tyr Met Pro Thr Tyr Leu Gln Met Val His Gly Leu Asn Pro
 35 40 45

Thr Gln Ala Gly Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile Gly
 50 55 60

Thr Ser Thr Val Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr Lys
 65 70 75 80

Trp Tyr Pro Phe Ile Gly Met Leu Ile Met Val Leu Ala Leu Val Leu
 85 90 95

Leu Ser Thr Leu Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu Tyr
 100 105 110

Phe Phe Val Phe Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu Val
 115 120 125

Leu Ile Val Gln Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala Thr

| | | |
|---|-----|---------|
| 130 | 135 | 140 |
| Gly Ser Asn Asn Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser Ala | | |
| 145 | 150 | 155 160 |
| Leu Ile Gly Gly Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr Glu | | |
| | 165 | 170 175 |
| Asn Val Pro Ala Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln Tyr | | |
| | 180 | 185 190 |
| Ala Ser Ala Met Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro His | | |
| | 195 | 200 205 |
| Leu Val Glu Ser Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu Ser | | |
| | 210 | 215 220 |
| Tyr Asn Asp Ala Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile Ala | | |
| 225 | 230 | 235 240 |
| Val Val Ala Ala Ile Leu Leu Phe Phe Ile Arg Glu Asp His Leu Lys | | |
| | 245 | 250 255 |
| Glu Thr His Glu | | |
| | 260 | |

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 <212> DNA
 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(1732)
 <223> RXN02926

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 ttttcatccg tgaagatcac ctcaaggaaa cgcacgaata atg aca cac gaa act 115
 Met Thr His Glu Thr
 1 5
 tcc gtc ccc gga cct gcc gac gcg cag gtc gca gga gat acg aag ctg 163
 Ser Val Pro Gly Pro Ala Asp Ala Gln Val Ala Gly Asp Thr Lys Leu
 10 15 20
 cgc aaa ggc cgc gcg aag aag gaa aaa act cct tca tca atg acg cct 211
 Arg Lys Gly Arg Ala Lys Lys Glu Lys Thr Pro Ser Ser Met Thr Pro
 25 30 35
 gaa caa caa aag aaa gtc tgg tgg gtc ctc agc gcg ctg atg gtc gcc 259
 Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser Ala Leu Met Val Ala
 40 45 50
 atg atg atg gcc tcc ctt gac cag atg att ttc ggc aca gcc ctg cca 307

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Met | Met | Met | Ala | Ser | Leu | Asp | Gln | Met | Ile | Phe | Gly | Thr | Ala | Leu | Pro | | |
| 55 | | | | | | 60 | | | | | 65 | | | | | | |
| aca | atc | gtc | ggt | gaa | ctc | ggc | ggc | ggt | gac | cac | atg | atg | tgg | gtc | atc | 355 | |
| Thr | Ile | Val | Gly | Glu | Leu | Gly | Gly | Val | Asp | His | Met | Met | Trp | Val | Ile | | |
| 70 | | | | | 75 | | | | 80 | | | | | 85 | | | |
| acc | gca | tac | cta | ctt | gcc | gaa | acc | atc | atg | ctg | ccg | atc | tac | gga | aag | 403 | |
| Thr | Ala | Tyr | Leu | Leu | Ala | Glu | Thr | Ile | Met | Leu | Pro | Ile | Tyr | Gly | Lys | | |
| | | | | 90 | | | | 95 | | | | | | 100 | | | |
| ctc | ggc | gac | ctg | ggt | gga | cgt | aaa | ggt | ctc | ttc | atc | gga | gcc | ctc | ggc | 451 | |
| Leu | Gly | Asp | Leu | Val | Gly | Arg | Lys | Gly | Leu | Phe | Ile | Gly | Ala | Leu | Gly | | |
| | | | 105 | | | | | 110 | | | | | 115 | | | | |
| atc | ttc | ctg | atc | ggc | tcc | gtc | atc | ggc | ggg | ctt | gca | gga | aat | atg | acc | 499 | |
| Ile | Phe | Leu | Ile | Gly | Ser | Val | Ile | Gly | Gly | Leu | Ala | Gly | Asn | Met | Thr | | |
| | | 120 | | | | | 125 | | | | | 130 | | | | | |
| tgg | ttg | atc | gtc | ggc | cgt | gcc | gta | cag | ggc | atc | ggt | ggc | ggt | gga | ctg | 547 | |
| Trp | Leu | Ile | Val | Gly | Arg | Ala | Val | Gln | Gly | Ile | Gly | Gly | Gly | Gly | Leu | | |
| | 135 | | | | | 140 | | | | | 145 | | | | | | |
| atg | atc | ctc | tcg | cag | gca | atc | atc | gcg | gac | ggt | ggt | cca | gca | cgt | gaa | 595 | |
| Met | Ile | Leu | Ser | Gln | Ala | Ile | Ile | Ala | Asp | Val | Val | Pro | Ala | Arg | Glu | | |
| 150 | | | | | 155 | | | | 160 | | | | | | 165 | | |
| cgt | ggc | cgc | tac | atg | ggt | gtc | atg | ggt | gga | gtc | ttc | gga | ctc | tct | gca | 643 | |
| Arg | Gly | Arg | Tyr | Met | Gly | Val | Met | Gly | Gly | Val | Phe | Gly | Leu | Ser | Ala | | |
| | | | | 170 | | | | 175 | | | | | 180 | | | | |
| ggt | ctt | ggc | cca | cta | ctc | ggt | ggc | tgg | ttc | acc | gaa | gga | cca | ggc | tgg | 691 | |
| Val | Leu | Gly | Pro | Leu | Leu | Gly | Gly | Trp | Phe | Thr | Glu | Gly | Pro | Gly | Trp | | |
| | | 185 | | | | | | 190 | | | | | 195 | | | | |
| cgc | tgg | gca | ttc | tgg | atg | aac | atc | cca | ctg | gga | atc | atc | gcc | atc | ggt | 739 | |
| Arg | Trp | Ala | Phe | Trp | Met | Asn | Ile | Pro | Leu | Gly | Ile | Ile | Ala | Ile | Gly | | |
| | | 200 | | | | | 205 | | | | | 210 | | | | | |
| gtc | gcc | att | tac | ttc | ctg | gac | att | cca | aag | aag | agc | gtc | aag | ttc | cgc | 787 | |
| Val | Ala | Ile | Tyr | Phe | Leu | Asp | Ile | Pro | Lys | Lys | Ser | Val | Lys | Phe | Arg | | |
| | 215 | | | | | 220 | | | | | 225 | | | | | | |
| tgg | gat | tac | ctg | ggc | act | ttc | ttc | atg | atc | ggt | gcc | gca | acc | agc | ctg | 835 | |
| Trp | Asp | Tyr | Leu | Gly | Thr | Phe | Phe | Met | Ile | Val | Ala | Ala | Thr | Ser | Leu | | |
| 230 | | | | | 235 | | | | | 240 | | | | | 245 | | |
| atc | ctg | ttc | acc | acc | tgg | ggt | gga | tcc | cag | tac | gag | tgg | tct | gat | cca | 883 | |
| Ile | Leu | Phe | Thr | Thr | Trp | Gly | Gly | Ser | Gln | Tyr | Glu | Trp | Ser | Asp | Pro | | |
| | | | 250 | | | | | 255 | | | | | | 260 | | | |
| atc | atc | att | gga | ctg | atc | atc | acc | acc | atc | ggt | gcc | gct | gca | ctg | ctg | 931 | |
| Ile | Ile | Ile | Gly | Leu | Ile | Ile | Thr | Thr | Ile | Val | Ala | Ala | Ala | Leu | Leu | | |
| | | | 265 | | | | | 270 | | | | | 275 | | | | |
| ggt | ggt | gtg | gaa | ctg | cgc | gca | aaa | gat | cca | ttg | ggt | cca | atg | tcc | ttc | 979 | |
| Val | Val | Val | Glu | Leu | Arg | Ala | Lys | Asp | Pro | Leu | Val | Pro | Met | Ser | Phe | | |

| 280 | 285 | 290 | |
|---|-----|-----|------|
| ttc caa aac cgc aac ttc acg ctc acc acc att gca ggc ctg atc ctg | | | 1027 |
| Phe Gln Asn Arg Asn Phe Thr Leu Thr Thr Ile Ala Gly Leu Ile Leu | | | |
| 295 | 300 | 305 | |
| ggt atc gca atg ttc ggc atc atc ggc tac ctt ccg acc tac ctc cag | | | 1075 |
| Gly Ile Ala Met Phe Gly Ile Ile Gly Tyr Leu Pro Thr Tyr Leu Gln | | | |
| 310 | 315 | 320 | 325 |
| atg gtc cac gga atc aac gcc acc gaa gcc ggc tac atg ctg atc cca | | | 1123 |
| Met Val His Gly Ile Asn Ala Thr Glu Ala Gly Tyr Met Leu Ile Pro | | | |
| | 330 | 335 | 340 |
| atg atg gtc ggc atg atg ggt acc tcc atc tgg act ggt atc cgc atc | | | 1171 |
| Met Met Val Gly Met Met Gly Thr Ser Ile Trp Thr Gly Ile Arg Ile | | | |
| | 345 | 350 | 355 |
| tcc aac aca gga aag tac aaa ctc ttc cca cca atc ggc atg gtg gtt | | | 1219 |
| Ser Asn Thr Gly Lys Tyr Lys Leu Phe Pro Pro Ile Gly Met Val Val | | | |
| | 360 | 365 | 370 |
| acc ttc gtg gca ctg atc ttc ttt gcc cga atg gaa gtg tcc acc acc | | | 1267 |
| Thr Phe Val Ala Leu Ile Phe Phe Ala Arg Met Glu Val Ser Thr Thr | | | |
| | 375 | 380 | 385 |
| ctg tgg cag atc gga atc tac ctc ttc gtc ctc ggc gtc ggc ctg ggt | | | 1315 |
| Leu Trp Gln Ile Gly Ile Tyr Leu Phe Val Leu Gly Val Gly Leu Gly | | | |
| 390 | 395 | 400 | 405 |
| cta gcc atg cag gtt ctg gtc ctg atc gtt cag aac acc ctg cca acc | | | 1363 |
| Leu Ala Met Gln Val Leu Val Leu Ile Val Gln Asn Thr Leu Pro Thr | | | |
| | 410 | 415 | 420 |
| gcg gtg gtc gga tcc gca acc gct gtg aac aac ttc ttc cgt caa atc | | | 1411 |
| Ala Val Val Gly Ser Ala Thr Ala Val Asn Asn Phe Phe Arg Gln Ile | | | |
| | 425 | 430 | 435 |
| ggt tcc tca ctc gga tcc gcg ctg gtc ggt ggc atg ttc gtt ggc aac | | | 1459 |
| Gly Ser Ser Leu Gly Ser Ala Leu Val Gly Gly Met Phe Val Gly Asn | | | |
| | 440 | 445 | 450 |
| ttg gga acc ctc atg gaa gaa aga atg cca gca gcc atg gca caa ctt | | | 1507 |
| Leu Gly Thr Leu Met Glu Glu Arg Met Pro Ala Ala Met Ala Gln Leu | | | |
| | 455 | 460 | 465 |
| tca cca gaa gaa caa gcc gcc atg gca gcc caa ggc gga ctg gac tcc | | | 1555 |
| Ser Pro Glu Glu Gln Ala Ala Met Ala Ala Gln Gly Gly Leu Asp Ser | | | |
| 470 | 475 | 480 | 485 |
| aac gaa ttg acg ccg gca atc gtc aat caa ttg cca acc gcg ctc cac | | | 1603 |
| Asn Glu Leu Thr Pro Ala Ile Val Asn Gln Leu Pro Thr Ala Leu His | | | |
| | 490 | 495 | 500 |
| gat gcg ttc gcc ggt tcc tac aac gac gca ctc atc cca gtg ttc tac | | | 1651 |
| Asp Ala Phe Ala Gly Ser Tyr Asn Asp Ala Leu Ile Pro Val Phe Tyr | | | |
| | 505 | 510 | 515 |

gtg atg atg cca ctg atc ggc atc gcg ctg ctt ctc ttg ctg ttt att 1699
 Val Met Met Pro Leu Ile Gly Ile Ala Leu Leu Leu Leu Leu Phe Ile
 520 525 530

aag caa gaa aaa cta cgc gaa acc acc aca gac taaacacaaa acaaatgaga 1752
 Lys Gln Glu Lys Leu Arg Glu Thr Thr Thr Asp
 535 540

cct 1755

<210> 254

<211> 544

<212> PRT

<213> Corynebacterium glutamicum

<400> 254

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Gly Asp Thr Lys Leu Arg Lys Gly Arg Ala Lys Lys Glu Lys Thr Pro
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Ser Ser Met Thr Pro Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser
 35 40 45

Ala Leu Met Val Ala Met Met Met Ala Ser Leu Asp Gln Met Ile Phe
 50 55 60

Gly Thr Ala Leu Pro Thr Ile Val Gly Glu Leu Gly Gly Val Asp His
 65 70 75 80

Met Met Trp Val Ile Thr Ala Tyr Leu Leu Ala Glu Thr Ile Met Leu
 85 90 95

Pro Ile Tyr Gly Lys Leu Gly Asp Leu Val Gly Arg Lys Gly Leu Phe
 100 105 110

Ile Gly Ala Leu Gly Ile Phe Leu Ile Gly Ser Val Ile Gly Gly Leu
 115 120 125

Ala Gly Asn Met Thr Trp Leu Ile Val Gly Arg Ala Val Gln Gly Ile
 130 135 140

Gly Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile Ile Ala Asp Val
 145 150 155 160

Val Pro Ala Arg Glu Arg Gly Arg Tyr Met Gly Val Met Gly Gly Val
 165 170 175

Phe Gly Leu Ser Ala Val Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr
 180 185 190

Glu Gly Pro Gly Trp Arg Trp Ala Phe Trp Met Asn Ile Pro Leu Gly
 195 200 205

Ile Ile Ala Ile Gly Val Ala Ile Tyr Phe Leu Asp Ile Pro Lys Lys
 210 215 220
 Ser Val Lys Phe Arg Trp Asp Tyr Leu Gly Thr Phe Phe Met Ile Val
 225 230 235 240
 Ala Ala Thr Ser Leu Ile Leu Phe Thr Thr Trp Gly Gly Ser Gln Tyr
 245 250 255
 Glu Trp Ser Asp Pro Ile Ile Ile Gly Leu Ile Ile Thr Thr Ile Val
 260 265 270
 Ala Ala Ala Leu Leu Val Val Val Glu Leu Arg Ala Lys Asp Pro Leu
 275 280 285
 Val Pro Met Ser Phe Phe Gln Asn Arg Asn Phe Thr Leu Thr Thr Ile
 290 295 300
 Ala Gly Leu Ile Leu Gly Ile Ala Met Phe Gly Ile Ile Gly Tyr Leu
 305 310 315 320
 Pro Thr Tyr Leu Gln Met Val His Gly Ile Asn Ala Thr Glu Ala Gly
 325 330 335
 Tyr Met Leu Ile Pro Met Met Val Gly Met Met Gly Thr Ser Ile Trp
 340 345 350
 Thr Gly Ile Arg Ile Ser Asn Thr Gly Lys Tyr Lys Leu Phe Pro Pro
 355 360 365
 Ile Gly Met Val Val Thr Phe Val Ala Leu Ile Phe Phe Ala Arg Met
 370 375 380
 Glu Val Ser Thr Thr Leu Trp Gln Ile Gly Ile Tyr Leu Phe Val Leu
 385 390 395 400
 Gly Val Gly Leu Gly Leu Ala Met Gln Val Leu Val Leu Ile Val Gln
 405 410 415
 Asn Thr Leu Pro Thr Ala Val Val Gly Ser Ala Thr Ala Val Asn Asn
 420 425 430
 Phe Phe Arg Gln Ile Gly Ser Ser Leu Gly Ser Ala Leu Val Gly Gly
 435 440 445
 Met Phe Val Gly Asn Leu Gly Thr Leu Met Glu Glu Arg Met Pro Ala
 450 455 460
 Ala Met Ala Gln Leu Ser Pro Glu Glu Gln Ala Ala Met Ala Ala Gln
 465 470 475 480
 Gly Gly Leu Asp Ser Asn Glu Leu Thr Pro Ala Ile Val Asn Gln Leu
 485 490 495
 Pro Thr Ala Leu His Asp Ala Phe Ala Gly Ser Tyr Asn Asp Ala Leu
 500 505 510

Ile Pro Val Phe Tyr Val Met Met Pro Leu Ile Gly Ile Ala Leu Leu
 515 520 525

Leu Leu Leu Phe Ile Lys Gln Glu Lys Leu Arg Glu Thr Thr Thr Asp
 530 535 540

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 <211> 1294
 <212> DNA
 <213> Corynebacterium glutamicum

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 <222> (101)..(1294)
 <223> FRXA01319

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ttttcatccg tgaagatcac ctcaaggaaa cgcacgaata atg aca cac gaa act 115
 Met Thr His Glu Thr
 1 5

tcc gtc ccc gga cct gcc gac gcg cag gtc gca gga gat acg aag ctg 163
 Ser Val Pro Gly Pro Ala Asp Ala Gln Val Ala Gly Asp Thr Lys Leu
 10 15 20

cgc aaa ggc cgc gcg aag aag gaa aaa act cct tca tca atg acg cct 211
 Arg Lys Gly Arg Ala Lys Lys Glu Lys Thr Pro Ser Ser Met Thr Pro
 25 30 35

gaa caa caa aag aaa gtc tgg tgg gtc ctc agc gcg ctg atg gtc gcc 259
 Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser Ala Leu Met Val Ala
 40 45 50

atg atg atg gcc tcc ctt gac cag atg att ttc ggc aca gcc ctg cca 307
 Met Met Met Ala Ser Leu Asp Gln Met Ile Phe Gly Thr Ala Leu Pro
 55 60 65

aca atc gtc ggt gaa ctc ggc ggc gtt gac cac atg atg tgg gtc atc 355
 Thr Ile Val Gly Glu Leu Gly Gly Val Asp His Met Met Trp Val Ile
 70 75 80 85

acc gca tac cta ctt gcc gaa acc atc atg ctg ccg atc tac gga aag 403
 Thr Ala Tyr Leu Leu Ala Glu Thr Ile Met Leu Pro Ile Tyr Gly Lys
 90 95 100

ctc ggc gac ctg gtt gga cgt aaa ggt ctc ttc atc gga gcc ctc ggc 451
 Leu Gly Asp Leu Val Gly Arg Lys Gly Leu Phe Ile Gly Ala Leu Gly
 105 110 115

atc ttc ctg atc ggc tcc gtc atc ggc ggg ctt gca gga aat atg acc 499
 Ile Phe Leu Ile Gly Ser Val Ile Gly Gly Leu Ala Gly Asn Met Thr

| 120 | 125 | 130 | |
|---|-----|-----|------|
| tgg ttg atc gtc ggc cgt gcc gta cag ggc atc ggt ggc ggt gga ctg | | | 547 |
| Trp Leu Ile Val Gly Arg Ala Val Gln Gly Ile Gly Gly Gly Gly Leu | | | |
| 135 | 140 | 145 | |
| atg atc ctc tcg cag gca atc atc gcg gac gtt gtt cca gca cgt gaa | | | 595 |
| Met Ile Leu Ser Gln Ala Ile Ile Ala Asp Val Val Pro Ala Arg Glu | | | |
| 150 | 155 | 160 | 165 |
| cgt ggc cgc tac atg ggt gtc atg ggt gga gtc ttc gga ctc tct gca | | | 643 |
| Arg Gly Arg Tyr Met Gly Val Met Gly Gly Val Phe Gly Leu Ser Ala | | | |
| 170 | 175 | 180 | |
| gtt ctt ggc cca cta ctc ggt ggc tgg ttc acc gaa gga cca ggc tgg | | | 691 |
| Val Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr Glu Gly Pro Gly Trp | | | |
| 185 | 190 | 195 | |
| cgc tgg gca ttc tgg atg aac atc cca ctg gga atc atc gcc atc ggt | | | 739 |
| Arg Trp Ala Phe Trp Met Asn Ile Pro Leu Gly Ile Ile Ala Ile Gly | | | |
| 200 | 205 | 210 | |
| gtc gcc att tac ttc ctg gac att cca aag aag agc gtc aag ttc cgc | | | 787 |
| Val Ala Ile Tyr Phe Leu Asp Ile Pro Lys Lys Ser Val Lys Phe Arg | | | |
| 215 | 220 | 225 | |
| tgg gat tac ctg ggc act ttc ttc atg atc gtt gcc gca acc agc ctg | | | 835 |
| Trp Asp Tyr Leu Gly Thr Phe Phe Met Ile Val Ala Ala Thr Ser Leu | | | |
| 230 | 235 | 240 | 245 |
| atc ctg ttc acc acc tgg ggt gga tcc cag tac gag tgg tct gat cca | | | 883 |
| Ile Leu Phe Thr Thr Trp Gly Gly Ser Gln Tyr Glu Trp Ser Asp Pro | | | |
| 250 | 255 | 260 | |
| atc atc att gga ctg atc atc acc acc atc gtt gcc gct gca ctg ctg | | | 931 |
| Ile Ile Ile Gly Leu Ile Ile Thr Thr Ile Val Ala Ala Ala Leu Leu | | | |
| 265 | 270 | 275 | |
| gtt gtt gtg gaa ctg cgc gca aaa gat cca ttg gtt cca atg tcc ttc | | | 979 |
| Val Val Val Glu Leu Arg Ala Lys Asp Pro Leu Val Pro Met Ser Phe | | | |
| 280 | 285 | 290 | |
| ttc caa aac cgc aac ttc acg ctc acc acc att gca ggc ctg atc ctg | | | 1027 |
| Phe Gln Asn Arg Asn Phe Thr Leu Thr Thr Ile Ala Gly Leu Ile Leu | | | |
| 295 | 300 | 305 | |
| ggt atc gca atg ttc ggc atc atc ggc tac ctt ccg acc tac ctc cag | | | 1075 |
| Gly Ile Ala Met Phe Gly Ile Ile Gly Tyr Leu Pro Thr Tyr Leu Gln | | | |
| 310 | 315 | 320 | 325 |
| atg gtc cac gga atc aac gcc acc gaa gcc ggc tac atg ctg atc cca | | | 1123 |
| Met Val His Gly Ile Asn Ala Thr Glu Ala Gly Tyr Met Leu Ile Pro | | | |
| 330 | 335 | 340 | |
| atg atg gtc ggc atg atg ggt acc tcc atc tgg act ggt atc cgc atc | | | 1171 |
| Met Met Val Gly Met Met Gly Thr Ser Ile Trp Thr Gly Ile Arg Ile | | | |
| 345 | 350 | 355 | |

tcc aac aca gga aag tac aaa ctc ttc cca cca atc ggc atg gtg gtt 1219
 Ser Asn Thr Gly Lys Tyr Lys Leu Phe Pro Pro Ile Gly Met Val Val
 360 365 370

acc ttc gtg gca ctg atc ttc ttt gcc cga atg gaa gtg tcc acc acc 1267
 Thr Phe Val Ala Leu Ile Phe Phe Ala Arg Met Glu Val Ser Thr Thr
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<211> 398

<212> PRT

<213> Corynebacterium glutamicum

<400> 256

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Ser Ser Met Thr Pro Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser
 35 40 45

Ala Leu Met Val Ala Met Met Met Ala Ser Leu Asp Gln Met Ile Phe
 50 55 60

Gly Thr Ala Leu Pro Thr Ile Val Gly Glu Leu Gly Gly Val Asp His
 65 70 75 80

Met Met Trp Val Ile Thr Ala Tyr Leu Leu Ala Glu Thr Ile Met Leu
 85 90 95

Pro Ile Tyr Gly Lys Leu Gly Asp Leu Val Gly Arg Lys Gly Leu Phe
 100 105 110

Ile Gly Ala Leu Gly Ile Phe Leu Ile Gly Ser Val Ile Gly Gly Leu
 115 120 125

Ala Gly Asn Met Thr Trp Leu Ile Val Gly Arg Ala Val Gln Gly Ile
 130 135 140

Gly Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile Ile Ala Asp Val
 145 150 155 160

Val Pro Ala Arg Glu Arg Gly Arg Tyr Met Gly Val Met Gly Gly Val
 165 170 175

Phe Gly Leu Ser Ala Val Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr
 180 185 190

Glu Gly Pro Gly Trp Arg Trp Ala Phe Trp Met Asn Ile Pro Leu Gly

| 195 | 200 | 205 |
|-------------------------|---------------------|-------------------------|
| Ile Ile Ala Ile Gly Val | Ala Ile Tyr Phe Leu | Asp Ile Pro Lys Lys |
| 210 | 215 | 220 |
| Ser Val Lys Phe Arg Trp | Asp Tyr Leu Gly Thr | Phe Phe Met Ile Val |
| 225 | 230 | 235 240 |
| Ala Ala Thr Ser Leu Ile | Leu Phe Thr Thr | Trp Gly Gly Ser Gln Tyr |
| 245 | 250 | 255 |
| Glu Trp Ser Asp Pro Ile | Ile Ile Gly Leu Ile | Ile Thr Thr Ile Val |
| 260 | 265 | 270 |
| Ala Ala Ala Leu Leu Val | Val Val Glu Leu Arg | Ala Lys Asp Pro Leu |
| 275 | 280 | 285 |
| Val Pro Met Ser Phe Phe | Gln Asn Arg Asn Phe | Thr Leu Thr Thr Ile |
| 290 | 295 | 300 |
| Ala Gly Leu Ile Leu Gly | Ile Ala Met Phe Gly | Ile Ile Gly Tyr Leu |
| 305 | 310 | 315 320 |
| Pro Thr Tyr Leu Gln Met | Val His Gly Ile Asn | Ala Thr Glu Ala Gly |
| 325 | 330 | 335 |
| Tyr Met Leu Ile Pro Met | Met Val Gly Met Met | Gly Thr Ser Ile Trp |
| 340 | 345 | 350 |
| Thr Gly Ile Arg Ile Ser | Asn Thr Gly Lys Tyr | Lys Leu Phe Pro Pro |
| 355 | 360 | 365 |
| Ile Gly Met Val Val Thr | Phe Val Ala Leu Ile | Phe Phe Ala Arg Met |
| 370 | 375 | 380 |
| Glu Val Ser Thr Thr Leu | Trp Gln Ile Gly Ile | Tyr Leu Phe |
| 385 | 390 | 395 |

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<211> 1510

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (93)..(1487)

<223> RXA01578

<400> 257

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gtaaaacctc ggccgccaca gtcataccat tgatg atc gcc ctg ctg gtc gcg      113
                Met Ile Ala Leu Leu Val Ala
                  1                      5

gta ttc gcc ttc cag ctc aac gcc tcc atg ctg gcg ccg gca ctg gcc      161

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| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Val | Phe | Ala | Phe | Gln | Leu | Asn | Ala | Ser | Met | Leu | Ala | Pro | Ala | Leu | Ala | | |
| | | 10 | | | | | 15 | | | | | 20 | | | | | |
| acc | atg | gaa | act | gaa | ctt | aat | gca | aca | gct | gcc | caa | atc | ggc | atg | acg | 209 | |
| Thr | Met | Glu | Thr | Glu | Leu | Asn | Ala | Thr | Ala | Ala | Gln | Ile | Gly | Met | Thr | | |
| | | 25 | | | | 30 | | | | | 35 | | | | | | |
| cag | act | gct | ttc | ttc | acc | gcg | gcg | gcg | ctg | ttt | tcc | ctg | ttc | ctg | cca | 257 | |
| Gln | Thr | Ala | Phe | Phe | Thr | Ala | Ala | Ala | Leu | Phe | Ser | Leu | Phe | Leu | Pro | | |
| | | 40 | | | 45 | | | | | 50 | | | | | 55 | | |
| cgt | tgg | ggc | gat | ctg | att | ggt | cgc | cgc | aaa | gtg | ctg | gtc | ggc | atg | atg | 305 | |
| Arg | Trp | Gly | Asp | Leu | Ile | Gly | Arg | Arg | Lys | Val | Leu | Val | Gly | Met | Met | | |
| | | | | 60 | | | | | 65 | | | | | 70 | | | |
| att | gtc | acc | ggt | att | gga | tgt | gtt | gtc | gct | gcc | ttt | gct | ccg | aat | gtg | 353 | |
| Ile | Val | Thr | Gly | Ile | Gly | Cys | Val | Val | Ala | Ala | Phe | Ala | Pro | Asn | Val | | |
| | | | 75 | | | | | 80 | | | | | 85 | | | | |
| acc | atc | ctc | ttc | ctg | ggc | cgc | ctg | att | caa | ggt | gtt | gct | ggc | cca | acc | 401 | |
| Thr | Ile | Leu | Phe | Leu | Gly | Arg | Leu | Ile | Gln | Gly | Val | Ala | Gly | Pro | Thr | | |
| | | 90 | | | | | 95 | | | | | 100 | | | | | |
| gtg | cca | ctg | tgt | ctg | atc | att | ctg | cgc | cag | cag | gta | acc | aat | gaa | aag | 449 | |
| Val | Pro | Leu | Cys | Leu | Ile | Ile | Leu | Arg | Gln | Gln | Val | Thr | Asn | Glu | Lys | | |
| | 105 | | | | | 110 | | | | | 115 | | | | | | |
| caa | tat | gcg | cta | ctt | ctc | gga | att | gtt | acc | tct | gtc | aac | ggt | ggt | atc | 497 | |
| Gln | Tyr | Ala | Leu | Leu | Leu | Gly | Ile | Val | Thr | Ser | Val | Asn | Gly | Gly | Ile | | |
| | 120 | | | | 125 | | | | 130 | | | | | | 135 | | |
| ggc | ggc | gtg | gac | gcg | ctt | gct | ggt | ggc | tgg | ttg | gct | gaa | aca | ctt | ggt | 545 | |
| Gly | Gly | Val | Asp | Ala | Leu | Ala | Gly | Gly | Trp | Leu | Ala | Glu | Thr | Leu | Gly | | |
| | | | | 140 | | | | | 145 | | | | | 150 | | | |
| ttc | cgt | tcc | atc | ttc | tgg | gtc | atg | gct | gct | ttc | tgc | gct | gtc | gct | gcc | 593 | |
| Phe | Arg | Ser | Ile | Phe | Trp | Val | Met | Ala | Ala | Phe | Cys | Ala | Val | Ala | Ala | | |
| | | | 155 | | | | | 160 | | | | | 165 | | | | |
| ctc | gca | ctg | cct | ttc | agc | gtg | aag | gaa | tcc | acc | gct | gaa | gaa | acc | ccg | 641 | |
| Leu | Ala | Leu | Pro | Phe | Ser | Val | Lys | Glu | Ser | Thr | Ala | Glu | Glu | Thr | Pro | | |
| | | 170 | | | | | 175 | | | | | 180 | | | | | |
| aag | atg | gac | tgg | ctt | ggt | gtg | ctg | cca | ctg | gcg | gtg | tcc | att | gga | tct | 689 | |
| Lys | Met | Asp | Trp | Leu | Gly | Val | Leu | Pro | Leu | Ala | Val | Ser | Ile | Gly | Ser | | |
| | 185 | | | | | 190 | | | | | 195 | | | | | | |
| ttg | ctc | atg | gct | ttc | aac | gag | gcc | ggc | aaa | ctc | ggt | gcc | gcg | aac | tgg | 737 | |
| Leu | Leu | Met | Ala | Phe | Asn | Glu | Ala | Gly | Lys | Leu | Gly | Ala | Ala | Asn | Trp | | |
| | 200 | | | | 205 | | | | | 210 | | | | | 215 | | |
| att | ctg | gtg | gtt | gtg | ctg | ttc | atc | atc | ggt | atc | gcc | gga | gtc | atc | ttc | 785 | |
| Ile | Leu | Val | Val | Val | Leu | Phe | Ile | Ile | Gly | Ile | Ala | Gly | Val | Ile | Phe | | |
| | | | | 220 | | | | | 225 | | | | 230 | | | | |
| ttc | tac | aac | att | gaa | aag | cgc | gtt | aag | cac | ccg | ctg | gtc | agt | gtt | gaa | 833 | |
| Phe | Tyr | Asn | Ile | Glu | Lys | Arg | Val | Lys | His | Pro | Leu | Val | Ser | Val | Glu | | |

| 235 | 240 | 245 | |
|---|-----|-----|------|
| tac ctc ggt caa cga cgc acc tgg gca ttg ctg ctg agc acc ctt ctc Tyr Leu Gly Gln Arg Arg Thr Trp Ala Leu Leu Leu Ser Thr Leu Leu 250 255 260 | | | 881 |
| aca atg acc ggt gta ttc gcc gta atg aat ggt ctg ctg ccc aac ctt Thr Met Thr Gly Val Phe Ala Val Met Asn Gly Leu Leu Pro Asn Leu 265 270 275 | | | 929 |
| gcg cag gat gct gcc aac ggt gcc ggc atg tca gcg agc gtg gtg tcc Ala Gln Asp Ala Ala Asn Gly Ala Gly Met Ser Ala Ser Val Val Ser 280 285 290 295 | | | 977 |
| tgg tgg aca ctt acc cca tat gcg ctg gct ggc ttg gta ttc ggt cca Trp Trp Thr Leu Thr Pro Tyr Ala Leu Ala Gly Leu Val Phe Gly Pro 300 305 310 | | | 1025 |
| atc gcc gga att ctc gcc gga aaa ttt gga tac aag atc gtc ctg caa Ile Ala Gly Ile Leu Ala Gly Lys Phe Gly Tyr Lys Ile Val Leu Gln 315 320 325 | | | 1073 |
| att ggt atc gct gcc acc atc atc ggc gtt gcc gga gcc acc ttc tta Ile Gly Ile Ala Ala Thr Ile Ile Gly Val Ala Gly Ala Thr Phe Leu 330 335 340 | | | 1121 |
| gtc gga agc acc tcg cat ctc gcg tac ctc ggc atc tcc atc ttc gtg Val Gly Ser Thr Ser His Leu Ala Tyr Leu Gly Ile Ser Ile Phe Val 345 350 355 | | | 1169 |
| ggt att acc tat gca ggt att gcc aac atc atg ctc aac ggc ctg ggc Gly Ile Thr Tyr Ala Gly Ile Ala Asn Ile Met Leu Asn Gly Leu Gly 360 365 370 375 | | | 1217 |
| atc gtg ctc tcc cct gct aac aac caa ggc tat ctg cct ggc atg aac Ile Val Leu Ser Pro Ala Asn Asn Gln Gly Tyr Leu Pro Gly Met Asn 380 385 390 | | | 1265 |
| gca ggt gcc ttc aac cta ggt gca ggt att tcc ttc gcc atc ctc ttc Ala Gly Ala Phe Asn Leu Gly Ala Gly Ile Ser Phe Ala Ile Leu Phe 395 400 405 | | | 1313 |
| gca gtt tcc acg gca ttc agt gac aac ggc gga gga tac gcc gca ggc Ala Val Ser Thr Ala Phe Ser Asp Asn Gly Gly Gly Tyr Ala Ala Gly 410 415 420 | | | 1361 |
| atg tgg gct ggc gtg atc atc ttg gtc cta gcc ttc ctc tgc tcc ctg Met Trp Ala Gly Val Ile Ile Leu Val Leu Ala Phe Leu Cys Ser Leu 425 430 435 | | | 1409 |
| ctg atc cca cgc cca gaa tca atc acc gat aca gtg gca gcc aaa gtc Leu Ile Pro Arg Pro Glu Ser Ile Thr Asp Thr Val Ala Ala Lys Val 440 445 450 455 | | | 1457 |
| cag gct gaa gaa gcc gct caa gcc gcc agc taaatccaca aactgaacta Gln Ala Glu Glu Ala Ala Gln Ala Ala Ser 460 465 | | | 1507 |

agg

1510

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<211> 465

<212> PRT

<213> Corynebacterium glutamicum

<400> 258

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Ala Ala Gln Ile Gly Met Thr Gln Thr Ala Phe Phe Thr Ala Ala Ala
 35 40 45

Leu Phe Ser Leu Phe Leu Pro Arg Trp Gly Asp Leu Ile Gly Arg Arg
 50 55 60

Lys Val Leu Val Gly Met Met Ile Val Thr Gly Ile Gly Cys Val Val
 65 70 75 80

Ala Ala Phe Ala Pro Asn Val Thr Ile Leu Phe Leu Gly Arg Leu Ile
 85 90 95

Gln Gly Val Ala Gly Pro Thr Val Pro Leu Cys Leu Ile Ile Leu Arg
 100 105 110

Gln Gln Val Thr Asn Glu Lys Gln Tyr Ala Leu Leu Leu Gly Ile Val
 115 120 125

Thr Ser Val Asn Gly Gly Ile Gly Gly Val Asp Ala Leu Ala Gly Gly
 130 135 140

Trp Leu Ala Glu Thr Leu Gly Phe Arg Ser Ile Phe Trp Val Met Ala
 145 150 155 160

Ala Phe Cys Ala Val Ala Ala Leu Ala Leu Pro Phe Ser Val Lys Glu
 165 170 175

Ser Thr Ala Glu Glu Thr Pro Lys Met Asp Trp Leu Gly Val Leu Pro
 180 185 190

Leu Ala Val Ser Ile Gly Ser Leu Leu Met Ala Phe Asn Glu Ala Gly
 195 200 205

Lys Leu Gly Ala Ala Asn Trp Ile Leu Val Val Val Leu Phe Ile Ile
 210 215 220

Gly Ile Ala Gly Val Ile Phe Phe Tyr Asn Ile Glu Lys Arg Val Lys
 225 230 235 240

His Pro Leu Val Ser Val Glu Tyr Leu Gly Gln Arg Arg Thr Trp Ala
 245 250 255

Leu Leu Leu Ser Thr Leu Leu Thr Met Thr Gly Val Phe Ala Val Met
 260 265 270
 Asn Gly Leu Leu Pro Asn Leu Ala Gln Asp Ala Ala Asn Gly Ala Gly
 275 280 285
 Met Ser Ala Ser Val Val Ser Trp Trp Thr Leu Thr Pro Tyr Ala Leu
 290 295 300
 Ala Gly Leu Val Phe Gly Pro Ile Ala Gly Ile Leu Ala Gly Lys Phe
 305 310 315 320
 Gly Tyr Lys Ile Val Leu Gln Ile Gly Ile Ala Ala Thr Ile Ile Gly
 325 330 335
 Val Ala Gly Ala Thr Phe Leu Val Gly Ser Thr Ser His Leu Ala Tyr
 340 345 350
 Leu Gly Ile Ser Ile Phe Val Gly Ile Thr Tyr Ala Gly Ile Ala Asn
 355 360 365
 Ile Met Leu Asn Gly Leu Gly Ile Val Leu Ser Pro Ala Asn Asn Gln
 370 375 380
 Gly Tyr Leu Pro Gly Met Asn Ala Gly Ala Phe Asn Leu Gly Ala Gly
 385 390 395 400
 Ile Ser Phe Ala Ile Leu Phe Ala Val Ser Thr Ala Phe Ser Asp Asn
 405 410 415
 Gly Gly Gly Tyr Ala Ala Gly Met Trp Ala Gly Val Ile Ile Leu Val
 420 425 430
 Leu Ala Phe Leu Cys Ser Leu Leu Ile Pro Arg Pro Glu Ser Ile Thr
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 Asp Thr Val Ala Ala Lys Val Gln Ala Glu Glu Ala Ala Gln Ala Ala
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 Ser
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<211> 1470

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(1447)

<223> RXA02087

<400> 259

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| ccgggagacg | ctgccaacg | cgaaagtcga | gcaggtataa | atg | acg | cca | att | gtg | 115 | | | | | | | |
| | | | | Met | Thr | Pro | Ile | Val | | | | | | | | |
| | | | | 1 | | | | 5 | | | | | | | | |
| gag | tcc | agg | gcg | tgg | aaa | gct | ctg | ggc | gct | tta | agt | gtt | ggg | ctg | ttt | 163 |
| Glu | Ser | Arg | Ala | Trp | Lys | Ala | Leu | Gly | Ala | Leu | Ser | Val | Gly | Leu | Phe | |
| | | | 10 | | | | | 15 | | | | | | 20 | | |
| ctc | aca | ctg | ctt | gac | caa | tcg | ttg | gtg | gct | gtc | gcg | ctg | cca | aag | att | 211 |
| Leu | Thr | Leu | Leu | Asp | Gln | Ser | Leu | Val | Ala | Val | Ala | Leu | Pro | Lys | Ile | |
| | | | 25 | | | | | 30 | | | | | 35 | | | |
| caa | gag | gat | ttg | ggt | gcg | agc | ctg | aac | caa | gcg | gtg | tgg | gtg | tca | gcg | 259 |
| Gln | Glu | Asp | Leu | Gly | Ala | Ser | Leu | Asn | Gln | Ala | Val | Trp | Val | Ser | Ala | |
| | | 40 | | | | | 45 | | | | | 50 | | | | |
| gtt | tat | ttg | ctc | act | ttt | gcg | gtg | cca | ctg | ttg | att | act | ggg | cgc | ttg | 307 |
| Val | Tyr | Leu | Leu | Thr | Phe | Ala | Val | Pro | Leu | Leu | Ile | Thr | Gly | Arg | Leu | |
| | 55 | | | | | 60 | | | | | 65 | | | | | |
| ggt | gat | cgt | tat | gga | cag | cga | aat | att | tat | ctt | gcc | ggc | atg | gct | gtg | 355 |
| Gly | Asp | Arg | Tyr | Gly | Gln | Arg | Asn | Ile | Tyr | Leu | Ala | Gly | Met | Ala | Val | |
| | 70 | | | | 75 | | | | | 80 | | | | | 85 | |
| ttt | acc | ctc | gcg | gcg | ttg | gcc | tgt | gta | ttt | gca | cca | agc | atc | gaa | tgg | 403 |
| Phe | Thr | Leu | Ala | Ala | Leu | Ala | Cys | Val | Phe | Ala | Pro | Ser | Ile | Glu | Trp | |
| | | | | 90 | | | | | 95 | | | | | 100 | | |
| ttg | att | gct | gct | cgc | gcg | gtg | cag | ggc | ctg | ggc | gga | tct | ctt | ctt | aat | 451 |
| Leu | Ile | Ala | Ala | Arg | Ala | Val | Gln | Gly | Leu | Gly | Gly | Ser | Leu | Leu | Asn | |
| | | | 105 | | | | | 110 | | | | | 115 | | | |
| ccg | cag | ccc | ctg | agc | atc | att | cac | aag | att | ttc | gcg | cat | gat | cgt | agg | 499 |
| Pro | Gln | Pro | Leu | Ser | Ile | Ile | His | Lys | Ile | Phe | Ala | His | Asp | Arg | Arg | |
| | | 120 | | | | | 125 | | | | | 130 | | | | |
| gga | gcc | gcc | acc | ggg | gtg | tgg | agt | gct | gtt | gcc | tca | tca | gct | gga | ctt | 547 |
| Gly | Ala | Ala | Thr | Gly | Val | Trp | Ser | Ala | Val | Ala | Ser | Ser | Ala | Gly | Leu | |
| | 135 | | | | | 140 | | | | | 145 | | | | | |
| ttc | ggg | cca | gtt | atc | ggt | ggt | gtt | ctg | gtg | ggg | tgg | atc | agc | tgg | cgt | 595 |
| Phe | Gly | Pro | Val | Ile | Gly | Gly | Val | Leu | Val | Gly | Trp | Ile | Ser | Trp | Arg | |
| | 150 | | | | 155 | | | | | 160 | | | | | 165 | |
| gct | gtg | ttc | ttg | gtt | tat | gtg | ccg | ctc | gga | ttg | atc | tcc | cta | ttt | atg | 643 |
| Ala | Val | Phe | Leu | Val | Tyr | Val | Pro | Leu | Gly | Leu | Ile | Ser | Leu | Phe | Met | |
| | | | | 170 | | | | | 175 | | | | | 180 | | |
| gtg | gcg | cgt | tat | gtg | cct | aaa | ctt | ccc | acg | gga | acc | tcg | aag | atc | gat | 691 |
| Val | Ala | Arg | Tyr | Val | Pro | Lys | Leu | Pro | Thr | Gly | Thr | Ser | Lys | Ile | Asp | |
| | | | 185 | | | | | 190 | | | | | 195 | | | |
| tgg | ctc | tcg | ggt | gcg | gtc | tca | ctt | gtt | gct | gta | ctt | ggt | gtg | gtt | ctt | 739 |
| Trp | Leu | Ser | Gly | Ala | Val | Ser | Leu | | | | | | | | | |

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------------|-----|-----|-----|------|--|
| Ala | Leu | Gln | Gln | Gly | Pro | Glu | Leu | Gly | Trp | Gly | Thr | Leu | Ile | Trp | Val | | |
| 215 | | | | | | 220 | | | | | 225 | | | | | | |
| tcc | ctt | gcc | gtt | ggt | att | gct | gca | gct | gtg | ctc | ttt | ata | tgg | atg | caa | 835 | |
| Ser | Leu | Ala | Val | Gly | Ile | Ala | Ala | Ala | Val | Leu | Phe | Ile | Trp | Met | Gln | | |
| 230 | | | | | 235 | | | | 240 | | | | | | 245 | | |
| aca | aga | tcc | aag | gcg | cca | ctg | atg | ccg | ttg | agg | att | ttc | aag | acg | cgc | 883 | |
| Thr | Arg | Ser | Lys | Ala | Pro | Leu | Met | Pro | Leu | Arg | Ile | Phe | Lys | Thr | Arg | | |
| | | | | 250 | | | | 255 | | | | | | 260 | | | |
| aac | ttc | gcg | atc | ggt | gca | ttt | tcg | atc | ttc | agc | ctg | ggc | ttt | acg | gtg | 931 | |
| Asn | Phe | Ala | Ile | Gly | Ala | Phe | Ser | Ile | Phe | Ser | Leu | Gly | Phe | Thr | Val | | |
| | | | 265 | | | | | 270 | | | | | 275 | | | | |
| tat | tcc | gtt | aat | ttg | ccc | atc | atg | ttg | tat | ctg | caa | acg | gct | cag | gga | 979 | |
| Tyr | Ser | Val | Asn | Leu | Pro | Ile | Met | Leu | Tyr | Leu | Gln | Thr | Ala | Gln | Gly | | |
| | | 280 | | | | | 285 | | | | | 290 | | | | | |
| atg | tcg | tcg | cag | ttg | gcc | ggt | ttg | atg | ttg | gtt | ccg | atg | ggc | atc | atc | 1027 | |
| Met | Ser | Ser | Gln | Leu | Ala | Gly | Leu | Met | Leu | Val | Pro | Met | Gly | Ile | Ile | | |
| | 295 | | | | | 300 | | | | | 305 | | | | | | |
| tct | gtg | gtg | atg | tca | cca | gta | att | gga | cga | ttg | gtg | gat | cgc | ctg | gca | 1075 | |
| Ser | Val | Val | Met | Ser | Pro | Val | Ile | Gly | Arg | Leu | Val | Asp | Arg | Leu | Ala | | |
| 310 | | | | | 315 | | | | | 320 | | | | | 325 | | |
| cca | gga | atg | atc | tcc | aag | atc | gga | ttc | ggc | gcg | ctg | att | ttc | tcg | atg | 1123 | |
| Pro | Gly | Met | Ile | Ser | Lys | Ile | Gly | Phe | Gly | Ala | Leu | Ile | Phe | Ser | Met | | |
| | | | | 330 | | | | 335 | | | | | | 340 | | | |
| gcg | ttg | atg | gct | gtc | ttt | atg | atc | gcc | aac | cta | tcg | ccg | tgg | tgg | cta | 1171 | |
| Ala | Leu | Met | Ala | Val | Phe | Met | Ile | Ala | Asn | Leu | Ser | Pro | Trp | Trp | Leu | | |
| | | | 345 | | | | | 350 | | | | | 355 | | | | |
| ctc | atc | ccg | att | att | ttg | ttc | ggt | agc | tcc | aac | gcg | atg | agt | ttt | gca | 1219 | |
| Leu | Ile | Pro | Ile | Ile | Leu | Phe | Gly | Ser | Ser | Asn | Ala | Met | Ser | Phe | Ala | | |
| | | 360 | | | | | 365 | | | | | 370 | | | | | |
| ccg | aac | tct | gtg | att | gct | ctg | cgt | gat | gtt | ccg | cag | gat | tta | gtg | ggc | 1267 | |
| Pro | Asn | Ser | Val | Ile | Ala | Leu | Arg | Asp | Val | Pro | Gln | Asp | Leu | Val | Gly | | |
| | 375 | | | | | 380 | | | | | 385 | | | | | | |
| tct | gct | tct | ggt | ttt | tac | aac | acc | tca | cgc | cag | gtg | ggc | gct | gtt | ttg | 1315 | |
| Ser | Ala | Ser | Gly | Phe | Tyr | Asn | Thr | Ser | Arg | Gln | Val | Gly | Ala | Val | Leu | | |
| 390 | | | | | 395 | | | | | 400 | | | | | 405 | | |
| ggc | gcc | gct | acc | ttg | ggc | gct | gtg | atg | caa | ata | gga | gtg | ggc | acg | gtg | 1363 | |
| Gly | Ala | Ala | Thr | Leu | Gly | Ala | Val | Met | Gln | Ile | Gly | Val | Gly | Thr | Val | | |
| | | | 410 | | | | | | 415 | | | | | 420 | | | |
| tcc | ttc | ggt | gtt | gcc | atg | ggt | gcg | gca | atc | ctg | gtg | aca | ctc | gtg | ccc | 1411 | |
| Ser | Phe | Gly | Val | Ala | Met | Gly | Ala | Ala | Ile | Leu | Val | Thr | Leu | Val | Pro | | |
| | | | 425 | | | | | 430 | | | | | 435 | | | | |
| tta | atc | ttt | ggg | ttc | cta | gcg | gta | acc | caa | ttt | aga | tagttgctcc | | | | 1457 | |
| Leu | Ile | Phe | Gly | Phe | Leu | Ala | Val | Thr | Gln | Phe | Arg | | | | | | |

440

445

gattttctca cga

1470

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<213> Corynebacterium glutamicum

<400> 260

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Ala Leu Pro Lys Ile Gln Glu Asp Leu Gly Ala Ser Leu Asn Gln Ala
 35 40 45

Val Trp Val Ser Ala Val Tyr Leu Leu Thr Phe Ala Val Pro Leu Leu
 50 55 60

Ile Thr Gly Arg Leu Gly Asp Arg Tyr Gly Gln Arg Asn Ile Tyr Leu
 65 70 75 80

Ala Gly Met Ala Val Phe Thr Leu Ala Ala Leu Ala Cys Val Phe Ala
 85 90 95

Pro Ser Ile Glu Trp Leu Ile Ala Ala Arg Ala Val Gln Gly Leu Gly
 100 105 110

Gly Ser Leu Leu Asn Pro Gln Pro Leu Ser Ile Ile His Lys Ile Phe
 115 120 125

Ala His Asp Arg Arg Gly Ala Ala Thr Gly Val Trp Ser Ala Val Ala
 130 135 140

Ser Ser Ala Gly Leu Phe Gly Pro Val Ile Gly Gly Val Leu Val Gly
 145 150 155 160

Trp Ile Ser Trp Arg Ala Val Phe Leu Val Tyr Val Pro Leu Gly Leu
 165 170 175

Ile Ser Leu Phe Met Val Ala Arg Tyr Val Pro Lys Leu Pro Thr Gly
 180 185 190

Thr Ser Lys Ile Asp Trp Leu Ser Gly Ala Val Ser Leu Val Ala Val
 195 200 205

Leu Gly Val Val Leu Ala Leu Gln Gln Gly Pro Glu Leu Gly Trp Gly
 210 215 220

Thr Leu Ile Trp Val Ser Leu Ala Val Gly Ile Ala Ala Ala Val Leu
 225 230 235 240

Phe Ile Trp Met Gln Thr Arg Ser Lys Ala Pro Leu Met Pro Leu Arg

| 245 | | | | | 250 | | | | | 255 | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ile | Phe | Lys | Thr | Arg | Asn | Phe | Ala | Ile | Gly | Ala | Phe | Ser | Ile | Phe | Ser |
| | | | 260 | | | | | 265 | | | | | 270 | | |
| Leu | Gly | Phe | Thr | Val | Tyr | Ser | Val | Asn | Leu | Pro | Ile | Met | Leu | Tyr | Leu |
| | | 275 | | | | | 280 | | | | | 285 | | | |
| Gln | Thr | Ala | Gln | Gly | Met | Ser | Ser | Gln | Leu | Ala | Gly | Leu | Met | Leu | Val |
| | 290 | | | | | 295 | | | | | 300 | | | | |
| Pro | Met | Gly | Ile | Ile | Ser | Val | Val | Met | Ser | Pro | Val | Ile | Gly | Arg | Leu |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 |
| Val | Asp | Arg | Leu | Ala | Pro | Gly | Met | Ile | Ser | Lys | Ile | Gly | Phe | Gly | Ala |
| | | | | 325 | | | | | 330 | | | | | 335 | |
| Leu | Ile | Phe | Ser | Met | Ala | Leu | Met | Ala | Val | Phe | Met | Ile | Ala | Asn | Leu |
| | | | 340 | | | | | 345 | | | | | 350 | | |
| Ser | Pro | Trp | Trp | Leu | Leu | Ile | Pro | Ile | Ile | Leu | Phe | Gly | Ser | Ser | Asn |
| | | 355 | | | | | 360 | | | | | 365 | | | |
| Ala | Met | Ser | Phe | Ala | Pro | Asn | Ser | Val | Ile | Ala | Leu | Arg | Asp | Val | Pro |
| | 370 | | | | | 375 | | | | | 380 | | | | |
| Gln | Asp | Leu | Val | Gly | Ser | Ala | Ser | Gly | Phe | Tyr | Asn | Thr | Ser | Arg | Gln |
| 385 | | | | | | 390 | | | | | 395 | | | | 400 |
| Val | Gly | Ala | Val | Leu | Gly | Ala | Ala | Thr | Leu | Gly | Ala | Val | Met | Gln | Ile |
| | | | | 405 | | | | | 410 | | | | | 415 | |
| Gly | Val | Gly | Thr | Val | Ser | Phe | Gly | Val | Ala | Met | Gly | Ala | Ala | Ile | Leu |
| | | | 420 | | | | | 425 | | | | | 430 | | |
| Val | Thr | Leu | Val | Pro | Leu | Ile | Phe | Gly | Phe | Leu | Ala | Val | Thr | Gln | Phe |
| | | 435 | | | | | 440 | | | | | 445 | | | |

Arg

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<211> 1338

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

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<223> RXA02088

<400> 261

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ctagatataa aaggggcgca gggctagcct tgggtgtgaa atg tta act caa aaa 115
Met Leu Thr Gln Lys

1

5

| | |
|---|-----|
| ata gaa tta gag gct aaa cca aaa atc cca gag gag atc tgg gtg ctg | 163 |
| Ile Glu Leu Glu Ala Lys Pro Lys Ile Pro Glu Glu Ile Trp Val Leu | |
| 10 15 20 | |
| gtt gtg gct gcg ttt att att gcg ctg ggc tat ggc ctg att gcg ccg | 211 |
| Val Val Ala Ala Phe Ile Ile Ala Leu Gly Tyr Gly Leu Ile Ala Pro | |
| 25 30 35 | |
| att ttg cca cag ttt gtg gtc ggt ttt gat gta agt ttt gca gct gcc | 259 |
| Ile Leu Pro Gln Phe Val Val Gly Phe Asp Val Ser Phe Ala Ala Ala | |
| 40 45 50 | |
| agt gcg gtg gtg tcc atc ttt gcg ggc gcc cgg ttg ttg ttt gcg ccg | 307 |
| Ser Ala Val Val Ser Ile Phe Ala Gly Ala Arg Leu Leu Phe Ala Pro | |
| 55 60 65 | |
| atg tcg ggg agt ttg atc gat aag atc ggt tcc cgt cgt gtg tat ctc | 355 |
| Met Ser Gly Ser Leu Ile Asp Lys Ile Gly Ser Arg Arg Val Tyr Leu | |
| 70 75 80 85 | |
| act ggt tta ctc acc gtg gct atc acc acg ggg ctt gtt gcg ttg gcg | 403 |
| Thr Gly Leu Leu Thr Val Ala Ile Thr Thr Gly Leu Val Ala Leu Ala | |
| 90 95 100 | |
| cag gaa tac tgg cag att ctg ctg ctt cgt ggc atc gca ggt att ggt | 451 |
| Gln Glu Tyr Trp Gln Ile Leu Leu Leu Arg Gly Ile Ala Gly Ile Gly | |
| 105 110 115 | |
| tcc acc atg ttt acg gtc tct gcc atg ggc ctg atc gtg aag atg gcg | 499 |
| Ser Thr Met Phe Thr Val Ser Ala Met Gly Leu Ile Val Lys Met Ala | |
| 120 125 130 | |
| ccg gtg gag atc cgc ggg cgg tgt tcg tcg gta tat gcc agt tcg ttc | 547 |
| Pro Val Glu Ile Arg Gly Arg Cys Ser Ser Val Tyr Ala Ser Ser Phe | |
| 135 140 145 | |
| ctg ttt ggc aat att att ggc ccg gtt gtg ggt gct gcg atg tcc ggt | 595 |
| Leu Phe Gly Asn Ile Ile Gly Pro Val Val Gly Ala Ala Met Ser Gly | |
| 150 155 160 165 | |
| ttg ggc atg cgg tgg ccg ttc gcg att tat ggt gct tcc gtt ggc tta | 643 |
| Leu Gly Met Arg Trp Pro Phe Ala Ile Tyr Gly Ala Ser Val Gly Leu | |
| 170 175 180 | |
| gct gca ctt gtt gtg tgg tgg cgg atg ccg aaa acc aac gat tca ctt | 691 |
| Ala Ala Leu Val Val Trp Trp Arg Met Pro Lys Thr Asn Asp Ser Leu | |
| 185 190 195 | |
| cgg aag gct gat agc aat agt gtg ccg gcg ttg cgc ttt gct gag gca | 739 |
| Arg Lys Ala Asp Ser Asn Ser Val Pro Ala Leu Arg Phe Ala Glu Ala | |
| 200 205 210 | |
| att aag gat tct gcc tac cgc tcg gcg ttg ttt agt gct ttt gcc aat | 787 |
| Ile Lys Asp Ser Ala Tyr Arg Ser Ala Leu Phe Ser Ala Phe Ala Asn | |
| 215 220 225 | |

ggt tgg tcg aac ttt ggt gtg cgt gtg gcg gtt ctt cca ctg ttt gcc 835
 Gly Trp Ser Asn Phe Gly Val Arg Val Ala Val Leu Pro Leu Phe Ala
 230 235 240 245

gca gct gca ttt agc aat ggc gga gct att gcg ggt ttt gcc atg gct 883
 Ala Ala Ala Phe Ser Asn Gly Gly Ala Ile Ala Gly Phe Ala Met Ala
 250 255 260

gcg ttc gcc gct gga aat gct ttg tgt ctg caa ttc gcg ggc gat ctc 931
 Ala Phe Ala Ala Gly Asn Ala Leu Cys Leu Gln Phe Ala Gly Asp Leu
 265 270 275

tca gat cgc att ggc cgt aaa ccg atg att att tcc ggg ctg atc gtc 979
 Ser Asp Arg Ile Gly Arg Lys Pro Met Ile Ile Ser Gly Leu Ile Val
 280 285 290

aat gca gtg ttc acg gca atg atc gga ttc ggc aca gaa gtg tgg atc 1027
 Asn Ala Val Phe Thr Ala Met Ile Gly Phe Gly Thr Glu Val Trp Ile
 295 300 305

ctg atc acg gta tct gcg ttg gca ggt gct ggt gcg ggc ttg ctt aat 1075
 Leu Ile Thr Val Ser Ala Leu Ala Gly Ala Gly Ala Gly Leu Leu Asn
 310 315 320 325

cca agt cag cag gcg gtg ctc gct gat gtt ata gat tcc cgc ccc ggc 1123
 Pro Ser Gln Gln Ala Val Leu Ala Asp Val Ile Asp Ser Arg Pro Gly
 330 335 340

gga aaa gtc tta gcg aat ttc caa atg gcg cag gat ttc ggt gcg att 1171
 Gly Lys Val Leu Ala Asn Phe Gln Met Ala Gln Asp Phe Gly Ala Ile
 345 350 355

gtt ggc ccg att ctc gta ggc atg atc gca gaa cag gca ggc ttc caa 1219
 Val Gly Pro Ile Leu Val Gly Met Ile Ala Glu Gln Ala Gly Phe Gln
 360 365 370

atc gga ttc atg ctg tgt ggt gtg atc agt ttg ctg gct gcg gtc gca 1267
 Ile Gly Phe Met Leu Cys Gly Val Ile Ser Leu Leu Ala Ala Val Ala
 375 380 385

tgg atc ttc ggc cgg gag acg ctg cca acg gcg aaa gtc gag cag gta 1315
 Trp Ile Phe Gly Arg Glu Thr Leu Pro Thr Ala Lys Val Glu Gln Val
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<211> 405

<212> PRT

<213> Corynebacterium glutamicum

<400> 262

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 Gly Leu Ile Ala Pro Ile Leu Pro Gln Phe Val Val Gly Phe Asp Val
 35 40 45
 Ser Phe Ala Ala Ala Ser Ala Val Val Ser Ile Phe Ala Gly Ala Arg
 50 55 60
 Leu Leu Phe Ala Pro Met Ser Gly Ser Leu Ile Asp Lys Ile Gly Ser
 65 70 75 80
 Arg Arg Val Tyr Leu Thr Gly Leu Leu Thr Val Ala Ile Thr Thr Gly
 85 90 95
 Leu Val Ala Leu Ala Gln Glu Tyr Trp Gln Ile Leu Leu Leu Arg Gly
 100 105 110
 Ile Ala Gly Ile Gly Ser Thr Met Phe Thr Val Ser Ala Met Gly Leu
 115 120 125
 Ile Val Lys Met Ala Pro Val Glu Ile Arg Gly Arg Cys Ser Ser Val
 130 135 140
 Tyr Ala Ser Ser Phe Leu Phe Gly Asn Ile Ile Gly Pro Val Val Gly
 145 150 155 160
 Ala Ala Met Ser Gly Leu Gly Met Arg Trp Pro Phe Ala Ile Tyr Gly
 165 170 175
 Ala Ser Val Gly Leu Ala Ala Leu Val Val Trp Trp Arg Met Pro Lys
 180 185 190
 Thr Asn Asp Ser Leu Arg Lys Ala Asp Ser Asn Ser Val Pro Ala Leu
 195 200 205
 Arg Phe Ala Glu Ala Ile Lys Asp Ser Ala Tyr Arg Ser Ala Leu Phe
 210 215 220
 Ser Ala Phe Ala Asn Gly Trp Ser Asn Phe Gly Val Arg Val Ala Val
 225 230 235 240
 Leu Pro Leu Phe Ala Ala Ala Ala Phe Ser Asn Gly Gly Ala Ile Ala
 245 250 255
 Gly Phe Ala Met Ala Ala Phe Ala Ala Gly Asn Ala Leu Cys Leu Gln
 260 265 270
 Phe Ala Gly Asp Leu Ser Asp Arg Ile Gly Arg Lys Pro Met Ile Ile
 275 280 285
 Ser Gly Leu Ile Val Asn Ala Val Phe Thr Ala Met Ile Gly Phe Gly
 290 295 300
 Thr Glu Val Trp Ile Leu Ile Thr Val Ser Ala Leu Ala Gly Ala Gly
 305 310 315 320

Ala Gly Leu Leu Asn Pro Ser Gln Gln Ala Val Leu Ala Asp Val Ile
 325 330 335

Asp Ser Arg Pro Gly Gly Lys Val Leu Ala Asn Phe Gln Met Ala Gln
 340 345 350

Asp Phe Gly Ala Ile Val Gly Pro Ile Leu Val Gly Met Ile Ala Glu
 355 360 365

Gln Ala Gly Phe Gln Ile Gly Phe Met Leu Cys Gly Val Ile Ser Leu
 370 375 380

Leu Ala Ala Val Ala Trp Ile Phe Gly Arg Glu Thr Leu Pro Thr Ala
 385 390 395 400

Lys Val Glu Gln Val
 405

<210> 263
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 <213> Corynebacterium glutamicum

<220>
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 <222> (101)..(1216)
 <223> RXA00764

<400> 263
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acctgggacg actggattat taggggtgga attttcgctc atg aca ctc aag act 115
 Met Thr Leu Lys Thr
 1 5

agc gtt ttg gca cta ctc tta gat aac gtg cat gtt ctt ctg att gcg 163
 Ser Val Leu Ala Leu Leu Leu Asp Asn Val His Val Leu Leu Ile Ala
 10 15 20

aat cct gag tcg acc acg cag acg cag aaa ctt ttc cgt cgt gtg gtg 211
 Asn Pro Glu Ser Thr Thr Gln Thr Gln Lys Leu Phe Arg Arg Val Val
 25 30 35

cct gcg ttg atg gcg ctt gat ggt gtg tcg ctt gaa gcg agg ttt acg 259
 Pro Ala Leu Met Ala Leu Asp Gly Val Ser Leu Glu Ala Arg Phe Thr
 40 45 50

cac tat gga ggc cat gcg gag gaa atg gtt gcg ggt ttg acg gtg gat 307
 His Tyr Gly Gly His Ala Glu Glu Met Val Ala Gly Leu Thr Val Asp
 55 60 65

gat ttt gat gtg att atc ccc gcg ggt ggg gac ggc acc gtc aac gaa 355
 Asp Phe Asp Val Ile Ile Pro Ala Gly Gly Asp Gly Thr Val Asn Glu
 70 75 80 85

gtg ata aat ggg tta ctt ggg tcg gcg gaa ggt gat ttt aga aac ctt 403

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| Val | Ile | Asn | Gly | Leu | Leu | Gly | Ser | Ala | Glu | Gly | Asp | Phe | Arg | Asn | Leu | | |
| | | | | 90 | | | | | 95 | | | | | 100 | | | |
| | | | | | | | | | | | | | | | | | |
| gag | gat | ttg | ccg | gcg | att | gcg | gtg | ttg | cca | acg | ggg | tct | gcc | aat | gtg | 451 | |
| Glu | Asp | Leu | Pro | Ala | Ile | Ala | Val | Leu | Pro | Thr | Gly | Ser | Ala | Asn | Val | | |
| | | | 105 | | | | | 110 | | | | | 115 | | | | |
| | | | | | | | | | | | | | | | | | |
| ttt | gcc | cgt | gcg | ctt | ggt | tac | ccc | act | gac | ccg | tat | gct | gcc | gct | gat | 499 | |
| Phe | Ala | Arg | Ala | Leu | Gly | Tyr | Pro | Thr | Asp | Pro | Tyr | Ala | Ala | Ala | Asp | | |
| | | 120 | | | | | 125 | | | | | 130 | | | | | |
| | | | | | | | | | | | | | | | | | |
| gcc | ctg | gtg | gag | ttg | att | cgg | aag | aac | cac | acc | aga | act | atc | acc | ttg | 547 | |
| Ala | Leu | Val | Glu | Leu | Ile | Arg | Lys | Asn | His | Thr | Arg | Thr | Ile | Thr | Leu | | |
| | | 135 | | | | 140 | | | | | 145 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| ggt | acg | tgg | aag | ggt | gat | gat | cag | ggg | act | cgt | tgg | ttc | gcg | gtt | aat | 595 | |
| Gly | Thr | Trp | Lys | Gly | Asp | Asp | Gln | Gly | Thr | Arg | Trp | Phe | Ala | Val | Asn | | |
| 150 | | | | 155 | | | | | | 160 | | | | | 165 | | |
| | | | | | | | | | | | | | | | | | |
| gct | ggg | ttt | ggt | att | gat | gcg | gat | gtt | att | gcc | agg | gtc | gaa | cgg | gcg | 643 | |
| Ala | Gly | Phe | Gly | Ile | Asp | Ala | Asp | Val | Ile | Ala | Arg | Val | Glu | Arg | Ala | | |
| | | | 170 | | | | | 175 | | | | | 180 | | | | |
| | | | | | | | | | | | | | | | | | |
| aga | tct | ttc | ggc | ttt | gcg | gct | tca | ccg | ttg | ttg | tat | ctg | cag | gtg | agt | 691 | |
| Arg | Ser | Phe | Gly | Phe | Ala | Ala | Ser | Pro | Leu | Leu | Tyr | Leu | Gln | Val | Ser | | |
| | | 185 | | | | | | 190 | | | | | 195 | | | | |
| | | | | | | | | | | | | | | | | | |
| ctt | cgg | gcg | tgg | gtg | aaa | act | cag | att | aag | cca | ccg | aaa | att | acc | gtg | 739 | |
| Leu | Arg | Ala | Trp | Val | Lys | Thr | Gln | Ile | Lys | Pro | Pro | Lys | Ile | Thr | Val | | |
| | | 200 | | | | | 205 | | | | | 210 | | | | | |
| | | | | | | | | | | | | | | | | | |
| gag | gcg | gtg | gac | agc | aaa | ggg | cac | aaa | ttg | caa | aaa | gag | gaa | gtg | cca | 787 | |
| Glu | Ala | Val | Asp | Ser | Lys | Gly | His | Lys | Leu | Gln | Lys | Glu | Glu | Val | Pro | | |
| | | 215 | | | | 220 | | | | | 225 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| atg | ctg | ctt | gcc | tcg | aat | acc | aat | ccg | tgg | act | ttt | ttg | ggt | ccg | ctt | 835 | |
| Met | Leu | Leu | Ala | Ser | Asn | Thr | Asn | Pro | Trp | Thr | Phe | Leu | Gly | Pro | Leu | | |
| 230 | | | | | 235 | | | | | 240 | | | | | 245 | | |
| | | | | | | | | | | | | | | | | | |
| cct | gtg | gtg | aca | aat | ccg | cag | aat | tct | ttt | gac | aca | ggt | ctg | ggg | ctt | 883 | |
| Pro | Val | Val | Thr | Asn | Pro | Gln | Asn | Ser | Phe | Asp | Thr | Gly | Leu | Gly | Leu | | |
| | | | | 250 | | | | 255 | | | | | 260 | | | | |
| | | | | | | | | | | | | | | | | | |
| ttt | ggc | ttg | act | agt | gtg | cga | gga | ttc | ggg | gga | gtg | gca | gcg | atg | atg | 931 | |
| Phe | Gly | Leu | Thr | Ser | Val | Arg | Gly | Phe | Gly | Gly | Val | Ala | Ala | Met | Met | | |
| | | 265 | | | | | 270 | | | | | 275 | | | | | |
| | | | | | | | | | | | | | | | | | |
| cac | ctg | att | ggc | gtg | ggg | cat | ggt | cgg | aag | ttg | gag | aag | ttg | atc | gct | 979 | |
| His | Leu | Ile | Gly | Val | Gly | His | Gly | Arg | Lys | Leu | Glu | Lys | Leu | Ile | Ala | | |
| | | 280 | | | | | 285 | | | | | 290 | | | | | |
| | | | | | | | | | | | | | | | | | |
| aag | cgc | acc | att | gct | ttt | gat | gat | gcg | gag | aaa | gta | acg | ctc | acg | tgc | 1027 | |
| Lys | Arg | Thr | Ile | Ala | Phe | Asp | Asp | Ala | Glu | Lys | Val | Thr | Leu | Thr | Cys | | |
| | | 295 | | | | 300 | | | | | 305 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| gac | agc | gat | cag | cgt | ttc | caa | gtt | gat | ggt | gag | tat | gaa | ggc | aaa | cca | 1075 | |
| Asp | Ser | Asp | Gln | Arg | Phe | Gln | Val | Asp | Gly | Glu | Tyr | Glu | Gly | Lys | Pro | | |

| 310 | 315 | 320 | 325 | |
|---|-----|-----|-----|------|
| aca aag gtg gtg ttg gaa tca atc act gat gcg gtg cga gtg tat gcg | | | | 1123 |
| Thr Lys Val Val Leu Glu Ser Ile Thr Asp Ala Val Arg Val Tyr Ala | | | | |
| | 330 | 335 | 340 | |
| ccg aag acg cat ccg aca ccg ccg atc atg aat tgg gct gtc cat ttg | | | | 1171 |
| Pro Lys Thr His Pro Thr Pro Pro Ile Met Asn Trp Ala Val His Leu | | | | |
| | 345 | 350 | 355 | |
| ttt aag cac gtc cgt gat ttc ctc cgg gtg cgc acg ttt ggc atc | | | | 1216 |
| Phe Lys His Val Arg Asp Phe Leu Arg Val Arg Thr Phe Gly Ile | | | | |
| | 360 | 365 | 370 | |
| taggattcat cggagttttc ttc | | | | 1239 |

<210> 264

<211> 372

<212> PRT

<213> Corynebacterium glutamicum

<400> 264

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| Met Thr Leu Lys Thr Ser Val Leu Ala Leu Leu Leu Asp Asn Val His | | | | |
| 1 | 5 | 10 | 15 | |
| Val Leu Leu Ile Ala Asn Pro Glu Ser Thr Thr Gln Thr Gln Lys Leu | | | | |
| | 20 | 25 | 30 | |
| Phe Arg Arg Val Val Pro Ala Leu Met Ala Leu Asp Gly Val Ser Leu | | | | |
| | 35 | 40 | 45 | |
| Glu Ala Arg Phe Thr His Tyr Gly Gly His Ala Glu Glu Met Val Ala | | | | |
| | 50 | 55 | 60 | |
| Gly Leu Thr Val Asp Asp Phe Asp Val Ile Ile Pro Ala Gly Gly Asp | | | | |
| | 65 | 70 | 75 | 80 |
| Gly Thr Val Asn Glu Val Ile Asn Gly Leu Leu Gly Ser Ala Glu Gly | | | | |
| | 85 | 90 | 95 | |
| Asp Phe Arg Asn Leu Glu Asp Leu Pro Ala Ile Ala Val Leu Pro Thr | | | | |
| | 100 | 105 | 110 | |
| Gly Ser Ala Asn Val Phe Ala Arg Ala Leu Gly Tyr Pro Thr Asp Pro | | | | |
| | 115 | 120 | 125 | |
| Tyr Ala Ala Ala Asp Ala Leu Val Glu Leu Ile Arg Lys Asn His Thr | | | | |
| | 130 | 135 | 140 | |
| Arg Thr Ile Thr Leu Gly Thr Trp Lys Gly Asp Asp Gln Gly Thr Arg | | | | |
| | 145 | 150 | 155 | 160 |
| Trp Phe Ala Val Asn Ala Gly Phe Gly Ile Asp Ala Asp Val Ile Ala | | | | |
| | 165 | 170 | 175 | |
| Arg Val Glu Arg Ala Arg Ser Phe Gly Phe Ala Ala Ser Pro Leu Leu | | | | |


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<400> 265
tgacaccggc gcgacgtatg gcattactgg cgtcacccca atttacgatg acatctctgc 60
tcgcctcggc gacgtccttg ttccttacgt tctgatcggt ttg gtt cta gcg ttc 115
                                         Leu Val Leu Ala Phe
                                         1                               5
ctc gtg ctg ttg ctc gtg ttc cgg tcc att tqg qtc cca ttg atc gcg 163

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<400> 267
atgatgatgt cctcagcaag tccaagcgcc aagccatgct ggaaacaatt ctcgagctga 60

taccaagcca gacttaaatt tctaccttaa agtcttgagc atg act gtt cag gaa 115
                                     Met Thr Val Gln Glu
                                     1                               5

ttc gac cgc gcg acc aaa ccc aca cca aaa ccc cca att gtt tct tgg 163
Phe Asp Arg Ala Thr Lys Pro Thr Pro Lys Pro Pro Ile Val Ser Trp
                        10                               15                               20

gcg ttt tgg gat tgg ggt tcc gcc tct ttc aac gcg gtc ctc gtg acc 211

```

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Ala | Phe | Trp | Asp | Trp | Gly | Ser | Ala | Ser | Phe | Asn | Ala | Val | Leu | Val | Thr | | |
| | | | 25 | | | | | 30 | | | | | 35 | | | | |
| ttt | att | ttc | tcg | gtc | tat | ctc | act | gat | tca | gtc | ggc | gcc | acc | ctc | ccc | 259 | |
| Phe | Ile | Phe | Ser | Val | Tyr | Leu | Thr | Asp | Ser | Val | Gly | Ala | Thr | Leu | Pro | | |
| | | 40 | | | | | 45 | | | | | 50 | | | | | |
| gag | ggt | tcc | aac | gcc | aca | tca | ctg | tat | tcg | atg | gcg | gtc | gcc | atc | gct | 307 | |
| Glu | Gly | Ser | Asn | Ala | Thr | Ser | Leu | Tyr | Ser | Met | Ala | Val | Ala | Ile | Ala | | |
| | | 55 | | | | | 60 | | | | 65 | | | | | | |
| ggc | gtc | att | gtt | gcg | gtt | gtt | gcc | cca | gtc | atg | ggc | agg | cga | tca | gat | 355 | |
| Gly | Val | Ile | Val | Ala | Val | Val | Ala | Pro | Val | Met | Gly | Arg | Arg | Ser | Asp | | |
| | | 70 | | | | 75 | | | | 80 | | | | | 85 | | |
| atc | aag | ggc | act | cgc | cgc | agg | tca | ctg | cgc | atg | tgg | aca | ctt | gtc | acc | 403 | |
| Ile | Lys | Gly | Thr | Arg | Arg | Arg | Ser | Leu | Arg | Met | Trp | Thr | Leu | Val | Thr | | |
| | | | | 90 | | | | | 95 | | | | | 100 | | | |
| gtg | ttc | ttg | atg | ttt | tgt | ctc | ttt | aca | gta | aag | aac | act | gat | ccc | aca | 451 | |
| Val | Phe | Leu | Met | Phe | Cys | Leu | Phe | Thr | Val | Lys | Asn | Thr | Asp | Pro | Thr | | |
| | | | 105 | | | | | 110 | | | | | 115 | | | | |
| ttt | ttc | tgg | ttt | ggt | gta | gcc | atc | atg | gcg | atc | gcc | aac | atc | acc | ttt | 499 | |
| Phe | Phe | Trp | Phe | Gly | Val | Ala | Ile | Met | Ala | Ile | Ala | Asn | Ile | Thr | Phe | | |
| | | 120 | | | | | 125 | | | | | 130 | | | | | |
| gag | ttc | gct | gaa | gtt | cag | tac | tat | gcg | cag | ctc | tcc | caa | atc | tcg | acc | 547 | |
| Glu | Phe | Ala | Glu | Val | Gln | Tyr | Tyr | Ala | Gln | Leu | Ser | Gln | Ile | Ser | Thr | | |
| | | 135 | | | | 140 | | | | | 145 | | | | | | |
| cgc | gaa | aac | gtg | ggc | cga | gtt | tct | ggt | ttc | ggc | tgg | tcc | atg | ggt | tac | 595 | |
| Arg | Glu | Asn | Val | Gly | Arg | Val | Ser | Gly | Phe | Gly | Trp | Ser | Met | Gly | Tyr | | |
| | | | | | 155 | | | | | 160 | | | | | 165 | | |
| ttc | ggt | ggc | atc | gtt | cta | ctg | ctt | gtt | tgt | tac | cta | ggt | ttt | gtt | gcc | 643 | |
| Phe | Gly | Gly | Ile | Val | Leu | Leu | Leu | Val | Cys | Tyr | Leu | Gly | Phe | Val | Ala | | |
| | | | | 170 | | | | | 175 | | | | | 180 | | | |
| ggt | gat | ggc | gat | acc | cgc | gga | ttc | cta | aac | ctg | ccc | atc | gaa | gac | ggc | 691 | |
| Gly | Asp | Gly | Asp | Thr | Arg | Gly | Phe | Leu | Asn | Leu | Pro | Ile | Glu | Asp | Gly | | |
| | | | 185 | | | | | 190 | | | | | 195 | | | | |
| atg | aat | atc | cgc | ctc | gtc | gca | gtg | ctt | gca | gcc | gtt | tgg | ttc | ttg | gtc | 739 | |
| Met | Asn | Ile | Arg | Leu | Val | Ala | Val | Leu | Ala | Ala | Val | Trp | Phe | Leu | Val | | |
| | | 200 | | | | | 205 | | | | | 210 | | | | | |
| tct | gcg | att | ccg | gca | ctt | ctt | cga | gtc | cca | gaa | att | gag | gca | cag | gta | 787 | |
| Ser | Ala | Ile | Pro | Ala | Leu | Leu | Arg | Val | Pro | Glu | Ile | Glu | Ala | Gln | Val | | |
| | | 215 | | | | 220 | | | | | 225 | | | | | | |
| gct | gcc | gaa | gac | cac | ccc | aaa | ggc | ctc | ata | gct | gcc | tac | aag | gat | ctc | 835 | |
| Ala | Ala | Glu | Asp | His | Pro | Lys | Gly | Leu | Ile | Ala | Ala | Tyr | Lys | Asp | Leu | | |
| | | 230 | | | 235 | | | | 240 | | | | | 245 | | | |
| ttt | ggg | cag | atc | gct | gag | ctg | tgg | aaa | caa | gac | cgc | aac | tcc | gtg | tat | 883 | |
| Phe | Gly | Gln | Ile | Ala | Glu | Leu | Trp | Lys | Gln | Asp | Arg | Asn | Ser | Val | Tyr | | |

| 250 | 255 | 260 | |
|---|-----|-----|------|
| ttc ctc atc gca gca act gtt ttc cgt gac gga ctc gcc gga gta ttt Phe Leu Ile Ala Ala Thr Val Phe Arg Asp Gly Leu Ala Gly Val Phe 265 270 275 | | | 931 |
| acc ttc ggt gcc atc ctt gcg gtc tct gtg tac gga cta tct gcc ggt Thr Phe Gly Ala Ile Leu Ala Val Ser Val Tyr Gly Leu Ser Ala Gly 280 285 290 | | | 979 |
| gat gtc ctc ctc ttc ggt gtc gca gcc aac gtg gtc tct gcg ttg gga Asp Val Leu Leu Phe Gly Val Ala Ala Asn Val Val Ser Ala Leu Gly 295 300 305 | | | 1027 |
| gca ctc ctc gga gga ttc cta gac gat cgc gtc ggg cca aaa ccc atc Ala Leu Leu Gly Gly Phe Leu Asp Asp Arg Val Gly Pro Lys Pro Ile 310 315 320 325 | | | 1075 |
| atc ttg att tct ctt gcc atc atg atc gcc gat gct gca att ctc ttc Ile Leu Ile Ser Leu Ala Ile Met Ile Ala Asp Ala Ala Ile Leu Phe 330 335 340 | | | 1123 |
| ttc gtt gaa ggc ccc act aat ttc tgg atc ttc gga tta atc ctc tgt Phe Val Glu Gly Pro Thr Asn Phe Trp Ile Phe Gly Leu Ile Leu Cys 345 350 355 | | | 1171 |
| gcg ttt gtg gga cct gca cag tca gcg tcg aga agc tat tta aca cgt Ala Phe Val Gly Pro Ala Gln Ser Ala Ser Arg Ser Tyr Leu Thr Arg 360 365 370 | | | 1219 |
| ctt tcc cca gat ggc cag gaa ggc cag ctc ttc ggc ctt tat gcc act Leu Ser Pro Asp Gly Gln Glu Gly Gln Leu Phe Gly Leu Tyr Ala Thr 375 380 385 | | | 1267 |
| acc ggc cgt gcc gtg agt tgg atg gtg ccg tcg ctg ttt ggt gta ttt Thr Gly Arg Ala Val Ser Trp Met Val Pro Ser Leu Phe Gly Val Phe 390 395 400 405 | | | 1315 |
| gtg ggg ctc acc ggc gat gac cgc act ggt att ttg gcc atc gcg ctg Val Gly Leu Thr Gly Asp Asp Arg Thr Gly Ile Leu Ala Ile Ala Leu 410 415 420 | | | 1363 |
| att ctg cta ttc ggt att gtg ctg ctg agc atg gtg aag cca ccg cac Ile Leu Leu Phe Gly Ile Val Leu Leu Ser Met Val Lys Pro Pro His 425 430 435 | | | 1411 |
| aag gtg aag tagacaaagc gccacaaagg att Lys Val Lys 440 | | | 1443 |

<210> 268

<211> 440

<212> PRT

<213> Corynebacterium glutamicum

<400> 268

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 Pro Ile Val Ser Trp Ala Phe Trp Asp Trp Gly Ser Ala Ser Phe Asn
 20 25 30
 Ala Val Leu Val Thr Phe Ile Phe Ser Val Tyr Leu Thr Asp Ser Val
 35 40 45
 Gly Ala Thr Leu Pro Glu Gly Ser Asn Ala Thr Ser Leu Tyr Ser Met
 50 55 60
 Ala Val Ala Ile Ala Gly Val Ile Val Ala Val Val Ala Pro Val Met
 65 70 75 80
 Gly Arg Arg Ser Asp Ile Lys Gly Thr Arg Arg Arg Ser Leu Arg Met
 85 90 95
 Trp Thr Leu Val Thr Val Phe Leu Met Phe Cys Leu Phe Thr Val Lys
 100 105 110
 Asn Thr Asp Pro Thr Phe Phe Trp Phe Gly Val Ala Ile Met Ala Ile
 115 120 125
 Ala Asn Ile Thr Phe Glu Phe Ala Glu Val Gln Tyr Tyr Ala Gln Leu
 130 135 140
 Ser Gln Ile Ser Thr Arg Glu Asn Val Gly Arg Val Ser Gly Phe Gly
 145 150 155 160
 Trp Ser Met Gly Tyr Phe Gly Gly Ile Val Leu Leu Leu Val Cys Tyr
 165 170 175
 Leu Gly Phe Val Ala Gly Asp Gly Asp Thr Arg Gly Phe Leu Asn Leu
 180 185 190
 Pro Ile Glu Asp Gly Met Asn Ile Arg Leu Val Ala Val Leu Ala Ala
 195 200 205
 Val Trp Phe Leu Val Ser Ala Ile Pro Ala Leu Leu Arg Val Pro Glu
 210 215 220
 Ile Glu Ala Gln Val Ala Ala Glu Asp His Pro Lys Gly Leu Ile Ala
 225 230 235 240
 Ala Tyr Lys Asp Leu Phe Gly Gln Ile Ala Glu Leu Trp Lys Gln Asp
 245 250 255
 Arg Asn Ser Val Tyr Phe Leu Ile Ala Ala Thr Val Phe Arg Asp Gly
 260 265 270
 Leu Ala Gly Val Phe Thr Phe Gly Ala Ile Leu Ala Val Ser Val Tyr
 275 280 285
 Gly Leu Ser Ala Gly Asp Val Leu Leu Phe Gly Val Ala Ala Asn Val
 290 295 300

Val Ser Ala Leu Gly Ala Leu Leu Gly Gly Phe Leu Asp Asp Arg Val
 305 310 315 320
 Gly Pro Lys Pro Ile Ile Leu Ile Ser Leu Ala Ile Met Ile Ala Asp
 325 330 335
 Ala Ala Ile Leu Phe Phe Val Glu Gly Pro Thr Asn Phe Trp Ile Phe
 340 345 350
 Gly Leu Ile Leu Cys Ala Phe Val Gly Pro Ala Gln Ser Ala Ser Arg
 355 360 365
 Ser Tyr Leu Thr Arg Leu Ser Pro Asp Gly Gln Glu Gly Gln Leu Phe
 370 375 380
 Gly Leu Tyr Ala Thr Thr Gly Arg Ala Val Ser Trp Met Val Pro Ser
 385 390 395 400
 Leu Phe Gly Val Phe Val Gly Leu Thr Gly Asp Asp Arg Thr Gly Ile
 405 410 415
 Leu Ala Ile Ala Leu Ile Leu Leu Phe Gly Ile Val Leu Leu Ser Met
 420 425 430
 Val Lys Pro Pro His Lys Val Lys
 435 440

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 <212> DNA
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 <222> (101)..(817)
 <223> RXN00535

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 cctaaggagc tcacctttac tcaatgctct gatgacaccg atg tgg tgg gca ggc 115
 Met Trp Trp Ala Gly
 1 5
 atg agt acc gcg atg ctg gca tat ttc tta caa aca gta gca ctt ggt 163
 Met Ser Thr Ala Met Leu Ala Tyr Phe Leu Gln Thr Val Ala Leu Gly
 10 15 20
 ttc ggc acc ctc ttg gta gtg caa cca gtg ctt gtc ctg tcg ctg atg 211
 Phe Gly Thr Leu Leu Val Val Gln Pro Val Leu Val Leu Ser Leu Met
 25 30 35
 ttc acg ctg ccg ctc tca gca cga ttc aat ggc tac cga cta cgc cga 259
 Phe Thr Leu Pro Leu Ser Ala Arg Phe Asn Gly Tyr Arg Leu Arg Arg
 40 45 50

act gaa atc ttc tgg gct acc ctc ctc acc gta gcc gtg ggc atc atg 307
 Thr Glu Ile Phe Trp Ala Thr Leu Leu Thr Val Ala Val Gly Ile Met
 55 60 65

atc gtt ttg gga cgc ccc ctt ccc gga aac ccc cac ccc cca ctc gat 355
 Ile Val Leu Gly Arg Pro Leu Pro Gly Asn Pro His Pro Pro Leu Asp
 70 75 80 85

cga tgg att cca gta ctt tta gtc ggc gtt gca gta atg ggt gga atg 403
 Arg Trp Ile Pro Val Leu Leu Val Gly Val Ala Val Met Gly Gly Met
 90 95 100

tgg ctg ctt gcg gaa tac gta tta aag aag gac aaa gcc ctc atc ctt 451
 Trp Leu Leu Ala Glu Tyr Val Leu Lys Lys Asp Lys Ala Leu Ile Leu
 105 110 115

ggt ctt gtg acg ggt gca ttg ttt ggc tac gta gca gtg atg tcc aaa 499
 Gly Leu Val Thr Gly Ala Leu Phe Gly Tyr Val Ala Val Met Ser Lys
 120 125 130

gcc gcg gtg gat ctt ttt gtc cat caa ggc ata acg gga ctc atc ttg 547
 Ala Ala Val Asp Leu Phe Val His Gln Gly Ile Thr Gly Leu Ile Leu
 135 140 145

aac tgg gaa ggc tac ggc cta atc ctc acc gca tta ctt gga aca atc 595
 Asn Trp Glu Gly Tyr Gly Leu Ile Leu Thr Ala Leu Leu Gly Thr Ile
 150 155 160 165

gtg cag cag tat tcc ttt aac gct ggc gaa cta caa aaa tcg cta ccc 643
 Val Gln Gln Tyr Ser Phe Asn Ala Gly Glu Leu Gln Lys Ser Leu Pro
 170 175 180

gcc atg acc att gcc gaa cca att gtt gcc ttc agt ttg ggc tac ttg 691
 Ala Met Thr Ile Ala Glu Pro Ile Val Ala Phe Ser Leu Gly Tyr Leu
 185 190 195

gtt ctg ggc gaa aaa ttc caa gtc gtg gac tgg gaa tgg atc gcc atg 739
 Val Leu Gly Glu Lys Phe Gln Val Val Asp Trp Glu Trp Ile Ala Met
 200 205 210

ggc atc gca cta ctg gtg atg att gtt tcc acc att gca ctg tct cgt 787
 Gly Ile Ala Leu Leu Val Met Ile Val Ser Thr Ile Ala Leu Ser Arg
 215 220 225

aca agc aca atg ccg gcc gga tcg aaa agg taaaactcca aagttccccc 837
 Thr Ser Thr Met Pro Ala Gly Ser Lys Arg
 230 235

cga 840

<210> 270

<211> 239

<212> PRT

<213> Corynebacterium glutamicum

<400> 270

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 20 25 30
 Val Leu Ser Leu Met Phe Thr Leu Pro Leu Ser Ala Arg Phe Asn Gly
 35 40 45
 Tyr Arg Leu Arg Arg Thr Glu Ile Phe Trp Ala Thr Leu Leu Thr Val
 50 55 60
 Ala Val Gly Ile Met Ile Val Leu Gly Arg Pro Leu Pro Gly Asn Pro
 65 70 75 80
 His Pro Pro Leu Asp Arg Trp Ile Pro Val Leu Leu Val Gly Val Ala
 85 90 95
 Val Met Gly Gly Met Trp Leu Leu Ala Glu Tyr Val Leu Lys Lys Asp
 100 105 110
 Lys Ala Leu Ile Leu Gly Leu Val Thr Gly Ala Leu Phe Gly Tyr Val
 115 120 125
 Ala Val Met Ser Lys Ala Ala Val Asp Leu Phe Val His Gln Gly Ile
 130 135 140
 Thr Gly Leu Ile Leu Asn Trp Glu Gly Tyr Gly Leu Ile Leu Thr Ala
 145 150 155 160
 Leu Leu Gly Thr Ile Val Gln Gln Tyr Ser Phe Asn Ala Gly Glu Leu
 165 170 175
 Gln Lys Ser Leu Pro Ala Met Thr Ile Ala Glu Pro Ile Val Ala Phe
 180 185 190
 Ser Leu Gly Tyr Leu Val Leu Gly Glu Lys Phe Gln Val Val Asp Trp
 195 200 205
 Glu Trp Ile Ala Met Gly Ile Ala Leu Leu Val Met Ile Val Ser Thr
 210 215 220
 Ile Ala Leu Ser Arg Thr Ser Thr Met Pro Ala Gly Ser Lys Arg
 225 230 235

<210> 271

<211> 2472

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(2449)

<223> RXN00453

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Val Ile Ser Ala Trp
1 5

cta ctt att ttg gcc att gtt ggt ggt ctg gcc ctg acg atg cag aag 163
Leu Leu Ile Leu Ala Ile Val Gly Gly Leu Ala Leu Thr Met Gln Lys
10 15 20

ggg ttc agt aac tct ttc act att gaa gac acc cct tcg att gat gcc 211
Gly Phe Ser Asn Ser Phe Thr Ile Glu Asp Thr Pro Ser Ile Asp Ala
25 30 35

act gtt tct ctg gtt gaa aat ttc cct gat cag acg aac ccg gtg acg 259
Thr Val Ser Leu Val Glu Asn Phe Pro Asp Gln Thr Asn Pro Val Thr
40 45 50

gcc gcc gga gtt aac gtg gtt ttc caa tcc ccg gaa gga acc acg ctt 307
Ala Ala Gly Val Asn Val Val Phe Gln Ser Pro Glu Gly Thr Thr Leu
55 60 65

gat gat cct cag atg atg act gcg atg gat gca gtc gtt gat tac att 355
Asp Asp Pro Gln Met Met Thr Ala Met Asp Ala Val Val Asp Tyr Ile
70 75 80 85

gag gac aat ttg cct gat ttt ggt ggg gga gag cgc ttc ggc aat cct 403
Glu Asp Asn Leu Pro Asp Phe Gly Gly Gly Glu Arg Phe Gly Asn Pro
90 95 100

gtt gag gtg tct cct gcg ttg gaa gag atg gtc atc gag cag atg acc 451
Val Glu Val Ser Pro Ala Leu Glu Glu Met Val Ile Glu Gln Met Thr
105 110 115

agc atg ggg ctt cct gag gaa acc gct gca aag gat gct gcc aat ctg 499
Ser Met Gly Leu Pro Glu Glu Thr Ala Ala Lys Asp Ala Ala Asn Leu
120 125 130

gcg gtg ttg agc gaa gac aaa acc att ggc tac acc tct ttc aac att 547
Ala Val Leu Ser Glu Asp Lys Thr Ile Gly Tyr Thr Ser Phe Asn Ile
135 140 145

gat gtt gag gcc gca gaa tat gtg gag caa aaa cac cgc gat gtg atc 595
Asp Val Glu Ala Ala Glu Tyr Val Glu Gln Lys His Arg Asp Val Ile
150 155 160 165

aac gaa gcg atg caa atc ggt gaa gat tta ggt gtc cgg gtg gaa gcc 643
Asn Glu Ala Met Gln Ile Gly Glu Asp Leu Gly Val Arg Val Glu Ala
170 175 180

ggg gga cct gct ttc ggt gat cca att cag att gaa acc acc agt gag 691
Gly Gly Pro Ala Phe Gly Asp Pro Ile Gln Ile Glu Thr Thr Ser Glu
185 190 195

atc atc ggt att ggc atc gcg ttc atc gtg ttg att ttc acc ttt ggt 739
Ile Ile Gly Ile Gly Ile Ala Phe Ile Val Leu Ile Phe Thr Phe Gly
200 205 210

| | |
|---|------|
| tct ttg att gct gca ggc ttg cct ttg att acc gcg gtg atc ggc gtg Ser Leu Ile Ala Ala Gly Leu Pro Leu Ile Thr Ala Val Ile Gly Val 215 220 225 | 787 |
| ggc att ggt gcg ctg gca att gtg ctg gcc acg gcg ttt act gat ctc Gly Ile Gly Ala Leu Ala Ile Val Leu Ala Thr Ala Phe Thr Asp Leu 230 235 240 245 | 835 |
| aac aat gtg act cca gtg ctc gca gtg atg att ggc ctg gcc gtg ggc Asn Asn Val Thr Pro Val Leu Ala Val Met Ile Gly Leu Ala Val Gly 250 255 260 | 883 |
| att gac tac gcg ctg ttt att ttg tct agg tac cgt gcg gag tat aag Ile Asp Tyr Ala Leu Phe Ile Leu Ser Arg Tyr Arg Ala Glu Tyr Lys 265 270 275 | 931 |
| cgc atg cca cgt gcc gat gct gcc gga atg gcg gtg ggc aca gct ggt Arg Met Pro Arg Ala Asp Ala Ala Gly Met Ala Val Gly Thr Ala Gly 280 285 290 | 979 |
| agt gcg gtg gtg ttt gct ggc gcg acg gtg att atc gcg ctg gta gcc Ser Ala Val Val Phe Ala Gly Ala Thr Val Ile Ile Ala Leu Val Ala 295 300 305 | 1027 |
| ctc atc att gcg gat atc gga ttc ctc acg gcc atg ggt att tct gcg Leu Ile Ile Ala Asp Ile Gly Phe Leu Thr Ala Met Gly Ile Ser Ala 310 315 320 325 | 1075 |
| gcg ttt acg gtg ttc gtg gct gtg ctc att gcg ttg acg ttt atc ccg Ala Phe Thr Val Phe Val Ala Val Leu Ile Ala Leu Thr Phe Ile Pro 330 335 340 | 1123 |
| gcg ctg ttg ggt gtg ttt ggt ggt cat gcg ttc aag ggc aag atc cct Ala Leu Leu Gly Val Phe Gly Gly His Ala Phe Lys Gly Lys Ile Pro 345 350 355 | 1171 |
| gga att ggt gga aac cca acg cca aag cag acg tgg gag caa gcg ctt Gly Ile Gly Gly Asn Pro Thr Pro Lys Gln Thr Trp Glu Gln Ala Leu 360 365 370 | 1219 |
| aat cgt cgt tcc aag ggt cgc tca tgg gtc aag ctt gta cag aaa gca Asn Arg Arg Ser Lys Gly Arg Ser Trp Val Lys Leu Val Gln Lys Ala 375 380 385 | 1267 |
| ccg ggt ctt gtg gtg gca gtg gtg gtc ttg ggt ctt ggt gcc ttg acc Pro Gly Leu Val Val Ala Val Val Val Leu Gly Leu Gly Ala Leu Thr 390 395 400 405 | 1315 |
| att cct gca atg aac ctg cag ttg tca ctg cct tct gac tcc acc tcc Ile Pro Ala Met Asn Leu Gln Leu Ser Leu Pro Ser Asp Ser Thr Ser 410 415 420 | 1363 |
| aat att gat acc act cag cgt cag tcg gct gat ttg atg gca gag ggc Asn Ile Asp Thr Thr Gln Arg Gln Ser Ala Asp Leu Met Ala Glu Gly 425 430 435 | 1411 |

| | |
|---|------|
| ttt ggc gcg ggc gtt aat gcg ccg ttc ttg gtc atc gtc gat acg cat | 1459 |
| Phe Gly Ala Gly Val Asn Ala Pro Phe Leu Val Ile Val Asp Thr His | |
| 440 445 450 | |
| gag gtc aat gct gat tcc acc gca ttg cag cca ctg att gag gca cag | 1507 |
| Glu Val Asn Ala Asp Ser Thr Ala Leu Gln Pro Leu Ile Glu Ala Gln | |
| 455 460 465 | |
| gag cct gaa gag ggc gag ttc gat cgg gag cag gcg gct cgt ttt gct | 1555 |
| Glu Pro Glu Glu Gly Glu Phe Asp Arg Glu Gln Ala Ala Arg Phe Ala | |
| 470 475 480 485 | |
| acc tat atg tat gtc acc cag acc tac aat tcc aac atc gat gtg aag | 1603 |
| Thr Tyr Met Tyr Val Thr Gln Thr Tyr Asn Ser Asn Ile Asp Val Lys | |
| 490 495 500 | |
| aat gcg cag atc atc agc gtc aat gat gat ttc act gcg gcg cag att | 1651 |
| Asn Ala Gln Ile Ile Ser Val Asn Asp Asp Phe Thr Ala Ala Gln Ile | |
| 505 510 515 | |
| ctc gtg act cca tac acc gga cct gcg gat aaa gag acc cct gag ttg | 1699 |
| Leu Val Thr Pro Tyr Thr Gly Pro Ala Asp Lys Glu Thr Pro Glu Leu | |
| 520 525 530 | |
| atg cac gtg ctg cgt gcg cag gaa gct cag att gag gat gtt acg gga | 1747 |
| Met His Val Leu Arg Ala Gln Glu Ala Gln Ile Glu Asp Val Thr Gly | |
| 535 540 545 | |
| act gaa ctg ggt acc act ggg ttt acg gcg gtt cag ttg gac att act | 1795 |
| Thr Glu Leu Gly Thr Thr Gly Phe Thr Ala Val Gln Leu Asp Ile Thr | |
| 550 555 560 565 | |
| gag cag ctg gaa gac gca atg ccg gtt tac ctc gct gtg gtt gtt ggt | 1843 |
| Glu Gln Leu Glu Asp Ala Met Pro Val Tyr Leu Ala Val Val Val Gly | |
| 570 575 580 | |
| ttg gct att ttc ctc ctc att ctg gtg ttc cgt tcc ctg ctt gtt ccg | 1891 |
| Leu Ala Ile Phe Leu Leu Ile Leu Val Phe Arg Ser Leu Leu Val Pro | |
| 585 590 595 | |
| ctg gtt gct ggc ctt ggc ttc ttg ttg tct gtg ggt gcg gcc ttc ggt | 1939 |
| Leu Val Ala Gly Leu Gly Phe Leu Leu Ser Val Gly Ala Ala Phe Gly | |
| 600 605 610 | |
| gcg acg gtg ttg gtc tgg cag gag ggc ttc ggt ggc ttt gtg aac acc | 1987 |
| Ala Thr Val Leu Val Trp Gln Glu Gly Phe Gly Gly Phe Val Asn Thr | |
| 615 620 625 | |
| cct ggt ccg ctg att tcc ttc atg ccg atc ttc ctc atc ggc gtg acc | 2035 |
| Pro Gly Pro Leu Ile Ser Phe Met Pro Ile Phe Leu Ile Gly Val Thr | |
| 630 635 640 645 | |
| ttc ggt ttg gcc atg gac tat cag gtg ttc ctt gtg act cgc atg cgc | 2083 |
| Phe Gly Leu Ala Met Asp Tyr Gln Val Phe Leu Val Thr Arg Met Arg | |
| 650 655 660 | |
| gag cac tac acc cac cac aat ggc aag gga cag cct ggt tcc aag tac | 2131 |

Glu His Tyr Thr His His Asn Gly Lys Gly Gln Pro Gly Ser Lys Tyr
 665 670 675
 acc ccg gtt gag cag tca gtg att gaa ggc ttc acg cag ggc tcc cgc 2179
 Thr Pro Val Glu Gln Ser Val Ile Glu Gly Phe Thr Gln Gly Ser Arg
 680 685 690
 gtg gtt aca gca gcg gca ctg atc atg att gcc gtg ttc gtg gcg ttt 2227
 Val Val Thr Ala Ala Ala Leu Ile Met Ile Ala Val Phe Val Ala Phe
 695 700 705
 att gat cag ccg ttg cca ttt att aag atc ttc ggt ttc gcg ttg ggt 2275
 Ile Asp Gln Pro Leu Pro Phe Ile Lys Ile Phe Gly Phe Ala Leu Gly
 710 715 720 725
 gcg ggc gtg ttt ttc gat gct ttc ttc att cgc atg ggt ctg gtc ccc 2323
 Ala Gly Val Phe Phe Asp Ala Phe Phe Ile Arg Met Gly Leu Val Pro
 730 735 740
 gcg tcg atg ttc ctg atg ggc aag gcc acg tgg tgg atg cct aag tgg 2371
 Ala Ser Met Phe Leu Met Gly Lys Ala Thr Trp Trp Met Pro Lys Trp
 745 750 755
 ctg gat cga att ctg cca agt ttg gac att gaa ggc acc gca ctg gag 2419
 Leu Asp Arg Ile Leu Pro Ser Leu Asp Ile Glu Gly Thr Ala Leu Glu
 760 765 770
 aag gaa tgg gag gag aag cag gct gca cgt tagacttggc acctatgtca 2469
 Lys Glu Trp Glu Glu Lys Gln Ala Ala Arg
 775 780
 gat 2472

<210> 272
 <211> 783
 <212> PRT
 <213> Corynebacterium glutamicum

<400> 272
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 20 25 30
 Pro Ser Ile Asp Ala Thr Val Ser Leu Val Glu Asn Phe Pro Asp Gln
 35 40 45
 Thr Asn Pro Val Thr Ala Ala Gly Val Asn Val Val Phe Gln Ser Pro
 50 55 60
 Glu Gly Thr Thr Leu Asp Asp Pro Gln Met Met Thr Ala Met Asp Ala
 65 70 75 80
 Val Val Asp Tyr Ile Glu Asp Asn Leu Pro Asp Phe Gly Gly Gly Glu
 85 90 95

Arg Phe Gly Asn Pro Val Glu Val Ser Pro Ala Leu Glu Glu Met Val
 100 105 110
 Ile Glu Gln Met Thr Ser Met Gly Leu Pro Glu Glu Thr Ala Ala Lys
 115 120 125
 Asp Ala Ala Asn Leu Ala Val Leu Ser Glu Asp Lys Thr Ile Gly Tyr
 130 135 140
 Thr Ser Phe Asn Ile Asp Val Glu Ala Ala Glu Tyr Val Glu Gln Lys
 145 150 155 160
 His Arg Asp Val Ile Asn Glu Ala Met Gln Ile Gly Glu Asp Leu Gly
 165 170 175
 Val Arg Val Glu Ala Gly Gly Pro Ala Phe Gly Asp Pro Ile Gln Ile
 180 185 190
 Glu Thr Thr Ser Glu Ile Ile Gly Ile Gly Ile Ala Phe Ile Val Leu
 195 200 205
 Ile Phe Thr Phe Gly Ser Leu Ile Ala Ala Gly Leu Pro Leu Ile Thr
 210 215 220
 Ala Val Ile Gly Val Gly Ile Gly Ala Leu Ala Ile Val Leu Ala Thr
 225 230 235 240
 Ala Phe Thr Asp Leu Asn Asn Val Thr Pro Val Leu Ala Val Met Ile
 245 250 255
 Gly Leu Ala Val Gly Ile Asp Tyr Ala Leu Phe Ile Leu Ser Arg Tyr
 260 265 270
 Arg Ala Glu Tyr Lys Arg Met Pro Arg Ala Asp Ala Ala Gly Met Ala
 275 280 285
 Val Gly Thr Ala Gly Ser Ala Val Val Phe Ala Gly Ala Thr Val Ile
 290 295 300
 Ile Ala Leu Val Ala Leu Ile Ile Ala Asp Ile Gly Phe Leu Thr Ala
 305 310 315 320
 Met Gly Ile Ser Ala Ala Phe Thr Val Phe Val Ala Val Leu Ile Ala
 325 330 335
 Leu Thr Phe Ile Pro Ala Leu Leu Gly Val Phe Gly Gly His Ala Phe
 340 345 350
 Lys Gly Lys Ile Pro Gly Ile Gly Gly Asn Pro Thr Pro Lys Gln Thr
 355 360 365
 Trp Glu Gln Ala Leu Asn Arg Arg Ser Lys Gly Arg Ser Trp Val Lys
 370 375 380
 Leu Val Gln Lys Ala Pro Gly Leu Val Val Ala Val Val Val Leu Gly
 385 390 395 400

Leu Gly Ala Leu Thr Ile Pro Ala Met Asn Leu Gln Leu Ser Leu Pro
 405 410 415
 Ser Asp Ser Thr Ser Asn Ile Asp Thr Thr Gln Arg Gln Ser Ala Asp
 420 425 430
 Leu Met Ala Glu Gly Phe Gly Ala Gly Val Asn Ala Pro Phe Leu Val
 435 440 445
 Ile Val Asp Thr His Glu Val Asn Ala Asp Ser Thr Ala Leu Gln Pro
 450 455 460
 Leu Ile Glu Ala Gln Glu Pro Glu Glu Gly Glu Phe Asp Arg Glu Gln
 465 470 475 480
 Ala Ala Arg Phe Ala Thr Tyr Met Tyr Val Thr Gln Thr Tyr Asn Ser
 485 490 495
 Asn Ile Asp Val Lys Asn Ala Gln Ile Ile Ser Val Asn Asp Asp Phe
 500 505 510
 Thr Ala Ala Gln Ile Leu Val Thr Pro Tyr Thr Gly Pro Ala Asp Lys
 515 520 525
 Glu Thr Pro Glu Leu Met His Val Leu Arg Ala Gln Glu Ala Gln Ile
 530 535 540
 Glu Asp Val Thr Gly Thr Glu Leu Gly Thr Thr Gly Phe Thr Ala Val
 545 550 555 560
 Gln Leu Asp Ile Thr Glu Gln Leu Glu Asp Ala Met Pro Val Tyr Leu
 565 570 575
 Ala Val Val Val Gly Leu Ala Ile Phe Leu Leu Ile Leu Val Phe Arg
 580 585 590
 Ser Leu Leu Val Pro Leu Val Ala Gly Leu Gly Phe Leu Leu Ser Val
 595 600 605
 Gly Ala Ala Phe Gly Ala Thr Val Leu Val Trp Gln Glu Gly Phe Gly
 610 615 620
 Gly Phe Val Asn Thr Pro Gly Pro Leu Ile Ser Phe Met Pro Ile Phe
 625 630 635 640
 Leu Ile Gly Val Thr Phe Gly Leu Ala Met Asp Tyr Gln Val Phe Leu
 645 650 655
 Val Thr Arg Met Arg Glu His Tyr Thr His His Asn Gly Lys Gly Gln
 660 665 670
 Pro Gly Ser Lys Tyr Thr Pro Val Glu Gln Ser Val Ile Glu Gly Phe
 675 680 685
 Thr Gln Gly Ser Arg Val Val Thr Ala Ala Ala Leu Ile Met Ile Ala
 690 695 700

Val Phe Val Ala Phe Ile Asp Gln Pro Leu Pro Phe Ile Lys Ile Phe
705 710 715 720

Gly Phe Ala Leu Gly Ala Gly Val Phe Phe Asp Ala Phe Phe Ile Arg
725 730 735

Met Gly Leu Val Pro Ala Ser Met Phe Leu Met Gly Lys Ala Thr Trp
740 745 750

Trp Met Pro Lys Trp Leu Asp Arg Ile Leu Pro Ser Leu Asp Ile Glu
755 760 765

Gly Thr Ala Leu Glu Lys Glu Trp Glu Glu Lys Gln Ala Ala Arg
770 775 780

<210> 273

<211> 597

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(574)

<223> RXN00932

<400> 273

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aataaggtga tgtttcaacg attaggttac ggtaggggcc atg acg cca cag aaa 115
Met Thr Pro Gln Lys
1 5

ctt cac cgt ttt gca gcc ctt tta gaa atg ggt acc tgg acc ctg ctg 163
Leu His Arg Phe Ala Ala Leu Leu Glu Met Gly Thr Trp Thr Leu Leu
10 15 20

atc atc ggc atg atc tta aaa tac agt gga gtg aca gac gcc gta acc 211
Ile Ile Gly Met Ile Leu Lys Tyr Ser Gly Val Thr Asp Ala Val Thr
25 30 35

cct att gcc ggc ggt atc cac ggc ttt ggc ttc ctc tgt ttt gca gcc 259
Pro Ile Ala Gly Gly Ile His Gly Phe Gly Phe Leu Cys Phe Ala Ala
40 45 50

atc acc atc acc gtg tgg atc aat aat aag tgg aca ttc ccg cag ggt 307
Ile Thr Ile Thr Val Trp Ile Asn Asn Lys Trp Thr Phe Pro Gln Gly
55 60 65

atc gca ggt ttg atc gtc tct gtt atc ccg tgg gct gca ttg cca ttt 355
Ile Ala Gly Leu Ile Val Ser Val Ile Pro Trp Ala Ala Leu Pro Phe
70 75 80 85

gca ttg tgg gca gac aag aag ggc ctc gtt gcc ggc gga tgg cgc ttt 403
Ala Leu Trp Ala Asp Lys Lys Gly Leu Val Ala Gly Gly Trp Arg Phe
90 95 100

tca gat ccg tcc gaa aag cca cac act ttc ttt gac aag atc ttg gct 451
 Ser Asp Pro Ser Glu Lys Pro His Thr Phe Phe Asp Lys Ile Leu Ala
 105 110 115

caa ttg gtc agg cac cca atc cga tcc att tta att ctg ctg gtg att 499
 Gln Leu Val Arg His Pro Ile Arg Ser Ile Leu Ile Leu Leu Val Ile
 120 125 130

atc gcc gtc gtc ttc tct atc ttg ctg gcg atg gga cca cct tat gat 547
 Ile Ala Val Val Phe Ser Ile Leu Leu Ala Met Gly Pro Pro Tyr Asp
 135 140 145

cca gat gcc atc gca aac act gtg gat taaacaacag cctccttcac 594
 Pro Asp Ala Ile Ala Asn Thr Val Asp
 150 155

atg 597

<210> 274

<211> 158

<212> PRT

<213> Corynebacterium glutamicum

<400> 274

Met Thr Pro Gln Lys Leu His Arg Phe Ala Ala Leu Leu Glu Met Gly
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Thr Trp Thr Leu Leu Ile Ile Gly Met Ile Leu Lys Tyr Ser Gly Val
 20 25 30

Thr Asp Ala Val Thr Pro Ile Ala Gly Gly Ile His Gly Phe Gly Phe
 35 40 45

Leu Cys Phe Ala Ala Ile Thr Ile Thr Val Trp Ile Asn Asn Lys Trp
 50 55 60

Thr Phe Pro Gln Gly Ile Ala Gly Leu Ile Val Ser Val Ile Pro Trp
 65 70 75 80

Ala Ala Leu Pro Phe Ala Leu Trp Ala Asp Lys Lys Gly Leu Val Ala
 85 90 95

Gly Gly Trp Arg Phe Ser Asp Pro Ser Glu Lys Pro His Thr Phe Phe
 100 105 110

Asp Lys Ile Leu Ala Gln Leu Val Arg His Pro Ile Arg Ser Ile Leu
 115 120 125

Ile Leu Leu Val Ile Ile Ala Val Val Phe Ser Ile Leu Leu Ala Met
 130 135 140

Gly Pro Pro Tyr Asp Pro Asp Ala Ile Ala Asn Thr Val Asp
 145 150 155

<210> 275
 <211> 534
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (65)..(511)
 <223> RXN03022

<400> 275
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 agcagtg atc atc acc gct ggc atc ttg gta gcg acc gcg acc gcc ctc 109
 Val Ile Ile Thr Ala Gly Ile Leu Val Ala Thr Ala Thr Ala Leu
 1 5 10 15
 cta atg atc acc gcg gtc agc gag tca acg tac atc gtc atc tcc ctc 157
 Leu Met Ile Thr Ala Val Ser Glu Ser Thr Tyr Ile Val Ile Ser Leu
 20 25 30
 gcc ggc ttc tcc ctt tat ggc ctt ggc ctc gga ctc ttc gcc acc cca 205
 Ala Gly Phe Ser Leu Tyr Gly Leu Gly Leu Gly Leu Phe Ala Thr Pro
 35 40 45
 gtc acc gat act gcg ctt gga aca ctt ccc aaa gac cgt acc ggc gct 253
 Val Thr Asp Thr Ala Leu Gly Thr Leu Pro Lys Asp Arg Thr Gly Ala
 50 55 60
 ggt gca ggt gta ttc aag atg tcc tct tcc ctc ggc gca gca ctc ggc 301
 Gly Ala Gly Val Phe Lys Met Ser Ser Ser Leu Gly Ala Ala Leu Gly
 65 70 75
 atc gca atc tcc act tca gtg ttc ctc gca ctt cgc gac ggc acc tcc 349
 Ile Ala Ile Ser Thr Ser Val Phe Leu Ala Leu Arg Asp Gly Thr Ser
 80 85 90 95
 atc aac tcc gac gtc gca ctc gcc gga aca gtt tca ctt ggc atc aac 397
 Ile Asn Ser Asp Val Ala Leu Ala Gly Thr Val Ser Leu Gly Ile Asn
 100 105 110
 gtt gta ttc gca gca aca gcc acc atc acc gca gca gtc ctt att cca 445
 Val Val Phe Ala Ala Thr Ala Thr Ile Thr Ala Ala Val Leu Ile Pro
 115 120 125
 aaa gcc gct ggc aaa gtc tca caa acc agc atc acc ctt cct gag cca 493
 Lys Ala Ala Gly Lys Val Ser Gln Thr Ser Ile Thr Leu Pro Glu Pro
 130 135 140
 gct atc gct gta aaa atc taaaacttca ccaggacaga taa 534
 Ala Ile Ala Val Lys Ile
 145

<210> 276
 <211> 149
 <212> PRT

<213> Corynebacterium glutamicum

<400> 276

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Val Ile Ile Thr Ala Gly Ile Leu Val Ala Thr Ala Thr Ala Leu Leu
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Met Ile Thr Ala Val Ser Glu Ser Thr Tyr Ile Val Ile Ser Leu Ala
      20             25             30

Gly Phe Ser Leu Tyr Gly Leu Gly Leu Gly Leu Phe Ala Thr Pro Val
      35             40             45

Thr Asp Thr Ala Leu Gly Thr Leu Pro Lys Asp Arg Thr Gly Ala Gly
      50             55             60

Ala Gly Val Phe Lys Met Ser Ser Ser Leu Gly Ala Ala Leu Gly Ile
      65             70             75             80

Ala Ile Ser Thr Ser Val Phe Leu Ala Leu Arg Asp Gly Thr Ser Ile
      85             90             95

Asn Ser Asp Val Ala Leu Ala Gly Thr Val Ser Leu Gly Ile Asn Val
      100            105            110

Val Phe Ala Ala Thr Ala Thr Ile Thr Ala Ala Val Leu Ile Pro Lys
      115            120            125

Ala Ala Gly Lys Val Ser Gln Thr Ser Ile Thr Leu Pro Glu Pro Ala
      130            135            140

Ile Ala Val Lys Ile
145

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<210> 277

<211> 586

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(586)

<223> RXN03151

<400> 277

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agtatttggt taaccatcca cctcaaggag taaaacgcac gtg ctt tcc cac atc 115
                                   Val Leu Ser His Ile
                                   1             5

att gat gtc ctc gcc gac ccg atc gat ggc acc cca ctt gta ggc gcc 163
Ile Asp Val Leu Ala Asp Pro Ile Asp Gly Thr Pro Leu Val Gly Ala
      10             15             20

gaa gat ttc tca cgg ttg gtg tct gaa tct ggg cat tcc tac gat gtt 211
Glu Asp Phe Ser Arg Leu Val Ser Glu Ser Gly His Ser Tyr Asp Val

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| 25 | | | | | | | | | | 30 | | | | | 35 | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|--|--|
| gct | cgt | caa | ggg | tat | gtc | acc | ctg | gct | ggt | ggc | gca | ggt | ctg | cgc | tat | 259 | | | | |
| Ala | Arg | Gln | Gly | Tyr | Val | Thr | Leu | Ala | Gly | Gly | Ala | Gly | Leu | Arg | Tyr | | | | | |
| 40 | | | 45 | | | | | 50 | | | | | | | | | | | | |
| tca | ggc | gat | gat | gca | cag | atg | atc | gcg | gat | cgg | gaa | acc | ttc | ctt | tct | 307 | | | | |
| Ser | Gly | Asp | Asp | Ala | Gln | Met | Ile | Ala | Asp | Arg | Glu | Thr | Phe | Leu | Ser | | | | | |
| 55 | | | 60 | | | | | 65 | | | | | | | | | | | | |
| ggc | ggt | cac | ttc | gcg | ccc | ttc | gtg | gaa | gct | gtc | acc | gag | cat | gtt | caa | 355 | | | | |
| Gly | Gly | His | Phe | Ala | Pro | Phe | Val | Glu | Ala | Val | Thr | Glu | His | Val | Gln | | | | | |
| 70 | | | 75 | | | | | 80 | | | 85 | | | | | | | | | |
| gat | gtc | gtt | gac | cag | gca | ggc | ctt | agc | gat | gac | gca | cag | cca | gtg | gtc | 403 | | | | |
| Asp | Val | Val | Asp | Gln | Ala | Gly | Leu | Ser | Asp | Asp | Ala | Gln | Pro | Val | Val | | | | | |
| | | | 90 | | | | | 95 | | | 100 | | | | | | | | | |
| tgc | gaa | atc | ggc | gcg | gga | acc | ggc | tac | tac | ttg | tcc | cat | acc | ctt | gat | 451 | | | | |
| Cys | Glu | Ile | Gly | Ala | Gly | Thr | Gly | Tyr | Tyr | Leu | Ser | His | Thr | Leu | Asp | | | | | |
| 105 | | | 110 | | | | | | | | 115 | | | | | | | | | |
| tct | gtt | gca | gga | tct | cgc | gga | att | ggc | att | gac | gtt | tcc | gtg | cac | gcc | 499 | | | | |
| Ser | Val | Ala | Gly | Ser | Arg | Gly | Ile | Gly | Ile | Asp | Val | Ser | Val | His | Ala | | | | | |
| 120 | | | 125 | | | | | | | | 130 | | | | | | | | | |
| gca | aag | cgt | ttg | gca | aag | tgt | cac | cct | cgc | gtc | ggc | gca | gtc | atc | gcg | 547 | | | | |
| Ala | Lys | Arg | Leu | Ala | Lys | Cys | His | Pro | Arg | Val | Gly | Ala | Val | Ile | Ala | | | | | |
| 135 | | | 140 | | | | | 145 | | | | | | | | | | | | |
| aac | gca | tgg | gca | cgc | ctg | ccg | att | gca | gat | aac | tcc | tcg | | | | 586 | | | | |
| Asn | Ala | Trp | Ala | Arg | Leu | Pro | Ile | Ala | Asp | Asn | Ser | Ser | | | | | | | | |
| 150 | | | 155 | | | | | 160 | | | | | | | | | | | | |

<210> 278

<211> 162

<212> PRT

<213> Corynebacterium glutamicum

<400> 278

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Leu | Ser | His | Ile | Ile | Asp | Val | Leu | Ala | Asp | Pro | Ile | Asp | Gly | Thr |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Pro | Leu | Val | Gly | Ala | Glu | Asp | Phe | Ser | Arg | Leu | Val | Ser | Glu | Ser | Gly |
| | | | 20 | | | | | 25 | | | | | 30 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| His | Ser | Tyr | Asp | Val | Ala | Arg | Gln | Gly | Tyr | Val | Thr | Leu | Ala | Gly | Gly |
| | | 35 | | | | | 40 | | | | | 45 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Gly | Leu | Arg | Tyr | Ser | Gly | Asp | Asp | Ala | Gln | Met | Ile | Ala | Asp | Arg |
| | 50 | | | | | 55 | | | | | 60 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Thr | Phe | Leu | Ser | Gly | Gly | His | Phe | Ala | Pro | Phe | Val | Glu | Ala | Val |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Thr | Glu | His | Val | Gln | Asp | Val | Val | Asp | Gln | Ala | Gly | Leu | Ser | Asp | Asp |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

| | | | | | |
|---|-----|--|-----|--|-----|
| | 85 | | 90 | | 95 |
| Ala Gln Pro Val Val Cys Glu Ile Gly Ala Gly Thr Gly Tyr Tyr Leu | | | | | |
| | 100 | | 105 | | 110 |
| Ser His Thr Leu Asp Ser Val Ala Gly Ser Arg Gly Ile Gly Ile Asp | | | | | |
| | 115 | | 120 | | 125 |
| Val Ser Val His Ala Ala Lys Arg Leu Ala Lys Cys His Pro Arg Val | | | | | |
| | 130 | | 135 | | 140 |
| Gly Ala Val Ile Ala Asn Ala Trp Ala Arg Leu Pro Ile Ala Asp Asn | | | | | |
| | 145 | | 150 | | 155 |
| | | | | | 160 |

Ser Ser

<210> 279

<211> 543

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(543)

<223> RXN02832

<400> 279

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| cgc ggg cca gtg atg gat tat aca aat caa tca tta gta gca ttt ttc | 48 |
| Arg Gly Pro Val Met Asp Tyr Thr Asn Gln Ser Leu Val Ala Phe Phe | |
| 1 5 10 15 | |
| ttt aaa gca tta acg tca tat tta aag aaa cac aat tgt tta tat gtc | 96 |
| Phe Lys Ala Leu Thr Ser Tyr Leu Lys Lys His Asn Cys Leu Tyr Val | |
| 20 25 30 | |
| ctt gta gat cca tat tta att gaa aat tta cgc aat gca gac ggt gaa | 144 |
| Leu Val Asp Pro Tyr Leu Ile Glu Asn Leu Arg Asn Ala Asp Gly Glu | |
| 35 40 45 | |
| att gtt aaa tct tat gat aac cga gca ttt gtt aga aca atg gat aaa | 192 |
| Ile Val Lys Ser Tyr Asp Asn Arg Ala Phe Val Arg Thr Met Asp Lys | |
| 50 55 60 | |
| tta ggt tat aaa cac caa ggt ttc cct gta ggt tat gat tca atg agc | 240 |
| Leu Gly Tyr Lys His Gln Gly Phe Pro Val Gly Tyr Asp Ser Met Ser | |
| 65 70 75 80 | |
| caa atc cgt tgg ctg tca gtg tta gat tta aaa gat aag act gaa gac | 288 |
| Gln Ile Arg Trp Leu Ser Val Leu Asp Leu Lys Asp Lys Thr Glu Asp | |
| 85 90 95 | |
| caa ctt tta aaa gaa atg gat tat caa acg aga cgt aat att aaa aaa | 336 |
| Gln Leu Leu Lys Glu Met Asp Tyr Gln Thr Arg Arg Asn Ile Lys Lys | |
| 100 105 110 | |

aca tat gat att ggt gtc aaa act aaa acg tta acg att gat gaa acg 384
 Thr Tyr Asp Ile Gly Val Lys Thr Lys Thr Leu Thr Ile Asp Glu Thr
 115 120 125

caa act ttt ttc gac tta ttc cat atg gct gag gaa aag cac ggt ttc 432
 Gln Thr Phe Phe Asp Leu Phe His Met Ala Glu Glu Lys His Gly Phe
 130 135 140

aaa ttc cgt gag tta cca tac ttt gaa gaa atg caa aag tta tac gat 480
 Lys Phe Arg Glu Leu Pro Tyr Phe Glu Glu Met Gln Lys Leu Tyr Asp
 145 150 155 160

gac cac gcc atg tta aag ttg gcg tat att gat tta aac gag tat tta 528
 Asp His Ala Met Leu Lys Leu Ala Tyr Ile Asp Leu Asn Glu Tyr Leu
 165 170 175

aaa acg ttg caa tta 543
 Lys Thr Leu Gln Leu
 180

<210> 280

<211> 181

<212> PRT

<213> Corynebacterium glutamicum

<400> 280

Arg Gly Pro Val Met Asp Tyr Thr Asn Gln Ser Leu Val Ala Phe Phe
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Phe Lys Ala Leu Thr Ser Tyr Leu Lys Lys His Asn Cys Leu Tyr Val
 20 25 30

Leu Val Asp Pro Tyr Leu Ile Glu Asn Leu Arg Asn Ala Asp Gly Glu
 35 40 45

Ile Val Lys Ser Tyr Asp Asn Arg Ala Phe Val Arg Thr Met Asp Lys
 50 55 60

Leu Gly Tyr Lys His Gln Gly Phe Pro Val Gly Tyr Asp Ser Met Ser
 65 70 75 80

Gln Ile Arg Trp Leu Ser Val Leu Asp Leu Lys Asp Lys Thr Glu Asp
 85 90 95

Gln Leu Leu Lys Glu Met Asp Tyr Gln Thr Arg Arg Asn Ile Lys Lys
 100 105 110

Thr Tyr Asp Ile Gly Val Lys Thr Lys Thr Leu Thr Ile Asp Glu Thr
 115 120 125

Gln Thr Phe Phe Asp Leu Phe His Met Ala Glu Glu Lys His Gly Phe
 130 135 140

Lys Phe Arg Glu Leu Pro Tyr Phe Glu Glu Met Gln Lys Leu Tyr Asp
 145 150 155 160

Asp His Ala Met Leu Lys Leu Ala Tyr Ile Asp Leu Asn Glu Tyr Leu
 165 170 175

Lys Thr Leu Gln Leu
 180

<210> 281
 <211> 1539
 <212> DNA
 <213> Corynebacterium glutamicum

<220>
 <221> CDS
 <222> (101)..(1516)
 <223> RXN00165

<400> 281
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gactctcaaa gtggcggtgt cgcagcggcc gtggagcttt gtg gcg tct gct ggc 115
 Val Ala Ser Ala Gly
 1 5

atg gcg gcg tct ttt atc tgc aat ggg tta acg cct gtg att gtg ggt 163
 Met Ala Ala Ser Phe Ile Cys Asn Gly Leu Thr Pro Val Ile Val Gly
 10 15 20

aag gcg gtg gat gag gct att ggc acg agc gat ctg cag cga ttg tgg 211
 Lys Ala Val Asp Glu Ala Ile Gly Thr Ser Asp Leu Gln Arg Leu Trp
 25 30 35

ttc tgg att gcc atg ttg gcg gtt ctt ttc tta acg gcg atg acg gtg 259
 Phe Trp Ile Ala Met Leu Ala Val Leu Phe Leu Thr Ala Met Thr Val
 40 45 50

aac tgg att gct cgg tac atg ttg gtg cgg agc cag cag ttg gtc agc 307
 Asn Trp Ile Ala Arg Tyr Met Leu Val Arg Ser Gln Gln Leu Val Ser
 55 60 65

cat gat ttg cgc atg ttg gtg act gat cgg att caa gat ccg cgt ggt 355
 His Asp Leu Arg Met Leu Val Thr Asp Arg Ile Gln Asp Pro Arg Gly
 70 75 80 85

ttt gct gga aaa gag cgc act gcg ggt gga ttg ttg tcg att gcg tca 403
 Phe Ala Gly Lys Glu Arg Thr Ala Gly Gly Leu Leu Ser Ile Ala Ser
 90 95 100

tcg gat acg cag cgg gtg ggc gat atc gtc atg atg acg gtg ttc ccg 451
 Ser Asp Thr Gln Arg Val Gly Asp Ile Val Met Met Thr Val Phe Pro
 105 110 115

gtg gcg gaa ttg gcg tcg att att tat ggc gcc gtg gtg atg tac agc 499
 Val Ala Glu Leu Ala Ser Ile Ile Tyr Gly Ala Val Val Met Tyr Ser
 120 125 130

att aat ccg tgg ttg agt gtg gct gtg ctg att ggt gga ccg ctg ctg 547

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| Ile | Asn | Pro | Trp | Leu | Ser | Val | Ala | Val | Leu | Ile | Gly | Gly | Pro | Leu | Leu | | |
| 135 | | | | | | 140 | | | | | 145 | | | | | | |
| gtt | gtg | gtg | gct | att | cag | gtc | tca | aag | ccg | ttg | cag | aag | cgt | tcg | ggg | 595 | |
| Val | Val | Val | Ala | Ile | Gln | Val | Ser | Lys | Pro | Leu | Gln | Lys | Arg | Ser | Gly | | |
| 150 | | | | | 155 | | | | | 160 | | | | | 165 | | |
| gct | cgt | cag | cag | gcg | gtg | gca | cag | gct | gcg | gct | act | gca | act | gat | gtg | 643 | |
| Ala | Arg | Gln | Gln | Ala | Val | Ala | Gln | Ala | Ala | Ala | Thr | Ala | Thr | Asp | Val | | |
| | | | | 170 | - | | | | 175 | | | | | | 180 | | |
| gtg | cag | ggc | ttg | aga | att | ttg | aag | ggg | ttg | ggc | gcg | att | gtc | acg | gtg | 691 | |
| Val | Gln | Gly | Leu | Arg | Ile | Leu | Lys | Gly | Leu | Gly | Ala | Ile | Val | Thr | Val | | |
| | | | 185 | | | | | 190 | | | | | | 195 | | | |
| cgc | cgt | cgg | tac | gag | gcg | att | tct | ggg | gag | gct | tat | cgg | aag | acg | gtt | 739 | |
| Arg | Arg | Arg | Tyr | Glu | Ala | Ile | Ser | Gly | Glu | Ala | Tyr | Arg | Lys | Thr | Val | | |
| | | 200 | | | | | 205 | | | | | | 210 | | | | |
| cat | gcg | gat | gct | gcg | gaa | gct | cgc | ttg | aat | ggg | gtc | acc | gat | gcg | gcg | 787 | |
| His | Ala | Asp | Ala | Ala | Glu | Ala | Arg | Leu | Asn | Gly | Val | Thr | Asp | Ala | Ala | | |
| | 215 | | | | | 220 | | | | | 225 | | | | | | |
| ggc | gcc | atc | ttt | gtg | tcc | gcg | ttg | ggg | att | gga | gca | gga | ttt | ttg | gcg | 835 | |
| Gly | Ala | Ile | Phe | Val | Ser | Ala | Leu | Gly | Ile | Gly | Ala | Gly | Phe | Leu | Ala | | |
| 230 | | | | | 235 | | | | | 240 | | | | | 245 | | |
| ctg | caa | ggg | cag | atg | agt | att | ggg | gat | ttg | atc | acg | gtt | gtg | gga | ctc | 883 | |
| Leu | Gln | Gly | Gln | Met | Ser | Ile | Gly | Asp | Leu | Ile | Thr | Val | Val | Gly | Leu | | |
| | | | | 250 | | | | | 255 | | | | | 260 | | | |
| aca | cag | ttt | ttg | atc | atg | ccg | atg | acc | atg | ctt | ggg | cga | aat | gtg | gca | 931 | |
| Thr | Gln | Phe | Leu | Ile | Met | Pro | Met | Thr | Met | Leu | Gly | Arg | Asn | Val | Ala | | |
| | | | 265 | | | | 270 | | | | | | 275 | | | | |
| tcg | cgc | tgg | gca | tcg | gcg | gag | gcg | tcg | gca | aag | cgt | att | agg | gga | gtg | 979 | |
| Ser | Arg | Trp | Ala | Ser | Ala | Glu | Ala | Ser | Ala | Lys | Arg | Ile | Arg | Gly | Val | | |
| | | 280 | | | | 285 | | | | | | 290 | | | | | |
| ctc | ggg | gct | gat | ttt | gag | aga | gtg | tct | gcg | cat | gat | gcg | gac | aag | gct | 1027 | |
| Leu | Gly | Ala | Asp | Phe | Glu | Arg | Val | Ser | Ala | His | Asp | Ala | Asp | Lys | Ala | | |
| | 295 | | | | | 300 | | | | | 305 | | | | | | |
| gag | gag | att | atc | caa | caa | ctt | gcc | aaa | ggg | ttg | acg | gtt | att | cga | ggc | 1075 | |
| Glu | Glu | Ile | Ile | Gln | Gln | Leu | Ala | Lys | Gly | Leu | Thr | Val | Ile | Arg | Gly | | |
| 310 | | | | | 315 | | | | | 320 | | | | | 325 | | |
| act | gat | gag | cag | ctc | gtt | gag | gta | tta | gag | cag | ttg | cca | cgt | act | cgg | 1123 | |
| Thr | Asp | Glu | Gln | Leu | Val | Glu | Val | Leu | Glu | Gln | Leu | Pro | Arg | Thr | Arg | | |
| | | | | 330 | | | | | 335 | | | | | 340 | | | |
| gtg | att | gtg | gct | cct | cat | gcg | gcg | gat | ctt | ttt | gat | caa | agt | gtc | agg | 1171 | |
| Val | Ile | Val | Ala | Pro | His | Ala | Ala | Asp | Leu | Phe | Asp | Gln | Ser | Val | Arg | | |
| | | | 345 | | | | | 350 | | | | | 355 | | | | |
| gac | aat | gtg | cat | ccc | gtg | gca | gag | gtc | gcg | gag | aaa | gcc | att | gaa | gtt | 1219 | |
| Asp | Asn | Val | His | Pro | Val | Ala | Glu | Val | Ala | Glu | Lys | Ala | Ile | Glu | Val | | |

| 360 | 365 | 370 | |
|---|-----|-----|------|
| gcc tcc tgt gac gat att cca ggt ggt agt tcc aag att gtg ggc gag | | | 1267 |
| Ala Ser Cys Asp Asp Ile Pro Gly Gly Ser Ser Lys Ile Val Gly Glu | | | |
| 375 | 380 | 385 | |
| ggt gga cgg ttg ctc tcg ggt ggt cag cgt cag cgc gtt gca ctg gct | | | 1315 |
| Gly Gly Arg Leu Leu Ser Gly Gly Gln Arg Gln Arg Val Ala Leu Ala | | | |
| 390 | 395 | 400 | 405 |
| cgg gcg att gct ttt gat cca gag gtg ttg gtg ctt caa gat ccc aca | | | 1363 |
| Arg Ala Ile Ala Phe Asp Pro Glu Val Leu Val Leu Gln Asp Pro Thr | | | |
| 410 | 415 | 420 | |
| acg gca gtg gat tct gtg acg gag caa aac att gct cag caa gtg gca | | | 1411 |
| Thr Ala Val Asp Ser Val Thr Glu Gln Asn Ile Ala Gln Gln Val Ala | | | |
| 425 | 430 | 435 | |
| gca cac cgt gca gga aaa gtg acc att gtg ttt agt gag gca ccc gcg | | | 1459 |
| Ala His Arg Ala Gly Lys Val Thr Ile Val Phe Ser Glu Ala Pro Ala | | | |
| 440 | 445 | 450 | |
| tgg agt gcg gtg gct gat caa cac gtt gag gca gct gct ttg cgg gag | | | 1507 |
| Trp Ser Ala Val Ala Asp Gln His Val Glu Ala Ala Ala Leu Arg Glu | | | |
| 455 | 460 | 465 | |
| gtt atg aaa tgagtgggga gacgtcgaaa agc | | | 1539 |
| Val Met Lys | | | |
| 470 | | | |

<210> 282

<211> 472

<212> PRT

<213> Corynebacterium glutamicum

<400> 282

| | | | |
|---|-----|-----|----|
| Val Ala Ser Ala Gly Met Ala Ala Ser Phe Ile Cys Asn Gly Leu Thr | | | |
| 1 | 5 | 10 | 15 |
| Pro Val Ile Val Gly Lys Ala Val Asp Glu Ala Ile Gly Thr Ser Asp | | | |
| 20 | 25 | 30 | |
| Leu Gln Arg Leu Trp Phe Trp Ile Ala Met Leu Ala Val Leu Phe Leu | | | |
| 35 | 40 | 45 | |
| Thr Ala Met Thr Val Asn Trp Ile Ala Arg Tyr Met Leu Val Arg Ser | | | |
| 50 | 55 | 60 | |
| Gln Gln Leu Val Ser His Asp Leu Arg Met Leu Val Thr Asp Arg Ile | | | |
| 65 | 70 | 75 | 80 |
| Gln Asp Pro Arg Gly Phe Ala Gly Lys Glu Arg Thr Ala Gly Gly Leu | | | |
| 85 | 90 | 95 | |
| Leu Ser Ile Ala Ser Ser Asp Thr Gln Arg Val Gly Asp Ile Val Met | | | |
| 100 | 105 | 110 | |

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|
| Met | Thr | Val | Phe | Pro | Val | Ala | Glu | Leu | Ala | Ser | Ile | Ile | Tyr | Gly | Ala | | |
| | | 115 | | | | | 120 | | | | | 125 | | | | | |
| Val | Val | Met | Tyr | Ser | Ile | Asn | Pro | Trp | Leu | Ser | Val | Ala | Val | Leu | Ile | | |
| | | 130 | | | | 135 | | | | | 140 | | | | | | |
| Gly | Gly | Pro | Leu | Leu | Val | Val | Val | Ala | Ile | Gln | Val | Ser | Lys | Pro | Leu | | |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 | | |
| Gln | Lys | Arg | Ser | Gly | Ala | Arg | Gln | Gln | Ala | Val | Ala | Gln | Ala | Ala | Ala | | |
| | | | | 165 | | | | | 170 | | | | | 175 | | | |
| Thr | Ala | Thr | Asp | Val | Val | Gln | Gly | Leu | Arg | Ile | Leu | Lys | Gly | Leu | Gly | | |
| | | | 180 | | | | | 185 | | | | | 190 | | | | |
| Ala | Ile | Val | Thr | Val | Arg | Arg | Arg | Tyr | Glu | Ala | Ile | Ser | Gly | Glu | Ala | | |
| | | 195 | | | | | 200 | | | | | 205 | | | | | |
| Tyr | Arg | Lys | Thr | Val | His | Ala | Asp | Ala | Ala | Glu | Ala | Arg | Leu | Asn | Gly | | |
| | 210 | | | | | 215 | | | | | 220 | | | | | | |
| Val | Thr | Asp | Ala | Ala | Gly | Ala | Ile | Phe | Val | Ser | Ala | Leu | Gly | Ile | Gly | | |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 | | |
| Ala | Gly | Phe | Leu | Ala | Leu | Gln | Gly | Gln | Met | Ser | Ile | Gly | Asp | Leu | Ile | | |
| | | | | 245 | | | | | 250 | | | | | 255 | | | |
| Thr | Val | Val | Gly | Leu | Thr | Gln | Phe | Leu | Ile | Met | Pro | Met | Thr | Met | Leu | | |
| | | | 260 | | | | | 265 | | | | | 270 | | | | |
| Gly | Arg | Asn | Val | Ala | Ser | Arg | Trp | Ala | Ser | Ala | Glu | Ala | Ser | Ala | Lys | | |
| | | 275 | | | | | 280 | | | | | 285 | | | | | |
| Arg | Ile | Arg | Gly | Val | Leu | Gly | Ala | Asp | Phe | Glu | Arg | Val | Ser | Ala | His | | |
| | 290 | | | | | 295 | | | | | 300 | | | | | | |
| Asp | Ala | Asp | Lys | Ala | Glu | Glu | Ile | Ile | Gln | Gln | Leu | Ala | Lys | Gly | Leu | | |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 | | |
| Thr | Val | Ile | Arg | Gly | Thr | Asp | Glu | Gln | Leu | Val | Glu | Val | Leu | Glu | Gln | | |
| | | | | 325 | | | | | 330 | | | | | 335 | | | |
| Leu | Pro | Arg | Thr | Arg | Val | Ile | Val | Ala | Pro | His | Ala | Ala | Asp | Leu | Phe | | |
| | | | 340 | | | | | 345 | | | | | 350 | | | | |
| Asp | Gln | Ser | Val | Arg | Asp | Asn | Val | His | Pro | Val | Ala | Glu | Val | Ala | Glu | | |
| | | 355 | | | | 360 | | | | | | 365 | | | | | |
| Lys | Ala | Ile | Glu | Val | Ala | Ser | Cys | Asp | Asp | Ile | Pro | Gly | Gly | Ser | Ser | | |
| | 370 | | | | | 375 | | | | | 380 | | | | | | |
| Lys | Ile | Val | Gly | Glu | Gly | Gly | Arg | Leu | Leu | Ser | Gly | Gly | Gln | Arg | Gln | | |
| 385 | | | | | 390 | | | | | 395 | | | | | 400 | | |
| Arg | Val | Ala | Leu | Ala | Arg | Ala | Ile | Ala | Phe | Asp | Pro | Glu | Val | Leu | Val | | |
| | | | 405 | | | | | 410 | | | | | | 415 | | | |

Leu Gln Asp Pro Thr Thr Ala Val Asp Ser Val Thr Glu Gln Asn Ile
 420 425 430

Ala Gln Gln Val Ala Ala His Arg Ala Gly Lys Val Thr Ile Val Phe
 435 440 445

Ser Glu Ala Pro Ala Trp Ser Ala Val Ala Asp Gln His Val Glu Ala
 450 455 460

Ala Ala Leu Arg Glu Val Met Lys
 465 470

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<211> 1470

<212> DNA

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<220>

<221> CDS

<222> (101)..(1447)

<223> RXN01190

<400> 283

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gcagcgggggc aaggttgcggt ttggcgcatt ctttttgggg atg tgg cag ctg tcg 115
 Met Trp Gln Leu Ser
 1 5

gaa gca ttg gtg ccg att gcg att ggt ttg atc gtt gat cat gcg gtt 163
 Glu Ala Leu Val Pro Ile Ala Ile Gly Leu Ile Val Asp His Ala Val
 10 15 20

ctc aca aaa gat ctc cgc cga tta gtg gtc ggg ctt gtc gct ttt gtt 211
 Leu Thr Lys Asp Leu Arg Arg Leu Val Val Gly Leu Val Ala Phe Val
 25 30 35

gtg ctg ttt gtg gtg ttg agt ttt tct aat cgt ttc ggt tcg cgc gcg 259
 Val Leu Phe Val Val Leu Ser Phe Ser Asn Arg Phe Gly Ser Arg Ala
 40 45 50

ttg aat agg gcc gtg aac ttt gaa tcc cat gcg ctc cgc gta gag gta 307
 Leu Asn Arg Ala Val Asn Phe Glu Ser His Ala Leu Arg Val Glu Val
 55 60 65

gcc gat cat gcg ttg aag aat ctg gat ccg cgc aat ttg gtg cct ggc 355
 Ala Asp His Ala Leu Lys Asn Leu Asp Pro Arg Asn Leu Val Pro Gly
 70 75 80 85

gag gtg atg tcg cgg tcc acc gca gat gcg gat tct tcg acg cgt att 403
 Glu Val Met Ser Arg Ser Thr Ala Asp Ala Asp Ser Ser Thr Arg Ile
 90 95 100

ttc ggg cag atc gga acc ggt gtt tcg gct gcg acg gga ttt ctt ggt 451
 Phe Gly Gln Ile Gly Thr Gly Val Ser Ala Ala Thr Gly Phe Leu Gly

| 105 | 110 | 115 | |
|---|-----|-----|------|
| gca gcg acc tac ctg ttg atc agt gac tgg ctg gtc ggg ttg ttg gtg Ala Ala Thr Tyr Leu Leu Ile Ser Asp Trp Leu Val Gly Leu Leu Val 120 125 130 | | | 499 |
| ctt gtg ctg gta ccg atc att tcg gga gtg gtt gca ctg gct agc aag Leu Val Leu Val Pro Ile Ile Ser Gly Val Val Ala Leu Ala Ser Lys 135 140 145 | | | 547 |
| ggc att tct aaa agg agt gtc acc cag cag gag aag ttg gcg gag tct Gly Ile Ser Lys Arg Ser Val Thr Gln Gln Glu Lys Leu Ala Glu Ser 150 155 160 165 | | | 595 |
| ggc gcg cag gca agt gac atc atg atg ggg ctg cgc gtg atc aag gcg Gly Ala Gln Ala Ser Asp Ile Met Met Gly Leu Arg Val Ile Lys Ala 170 175 180 | | | 643 |
| atc ggt ggc gag cgt tgg gcc gtg aag act ttt gaa aag gcg tcg cag Ile Gly Gly Glu Arg Trp Ala Val Lys Thr Phe Glu Lys Ala Ser Gln 185 190 195 | | | 691 |
| gca tca gcg aga gcg gcg gtt gat act gca gtt gct tcg ggc aaa gtc Ala Ser Ala Arg Ala Ala Val Asp Thr Ala Val Ala Ser Gly Lys Val 200 205 210 | | | 739 |
| gct ggt att ggt gag ttg tcc att gcg gtg aat ttg gct gcg gtg ttg Ala Gly Ile Gly Glu Leu Ser Ile Ala Val Asn Leu Ala Ala Val Leu 215 220 225 | | | 787 |
| ttg ctt gct ggt tgg cgg gtc acc acg ggg gag ttg ggg cct ggc cag Leu Leu Ala Gly Trp Arg Val Thr Thr Gly Glu Leu Gly Pro Gly Gln 230 235 240 245 | | | 835 |
| ttg atc gca att gtg ggt gtg gcg gtg tat ttg tca gag ccg att cgc Leu Ile Ala Ile Val Gly Val Ala Val Tyr Leu Ser Glu Pro Ile Arg 250 255 260 | | | 883 |
| ttg ctg agc aac tcg att aat gcc tca gct att gcg cac ggt gca gcg Leu Leu Ser Asn Ser Ile Asn Ala Ser Ala Ile Ala His Gly Ala Ala 265 270 275 | | | 931 |
| gag cgg gtg gct aat ttc tta aac ctc gac gaa tct cag gca cag tac Glu Arg Val Ala Asn Phe Leu Asn Leu Asp Glu Ser Gln Ala Gln Tyr 280 285 290 | | | 979 |
| gaa agc agc gaa aca atc aat gac ggc gaa ttc ctc gtc atc gtg ccc Glu Ser Ser Glu Thr Ile Asn Asp Gly Glu Phe Leu Val Ile Val Pro 295 300 305 | | | 1027 |
| cca gcc agc acg ctt cca cac ggc gac aat atc ttg gct aca cct cat Pro Ala Ser Thr Leu Pro His Gly Asp Asn Ile Leu Ala Thr Pro His 310 315 320 325 | | | 1075 |
| gct gcc gac att ttc gaa ggt acc ttg cgg tca aat att tcc atg aat Ala Ala Asp Ile Phe Glu Gly Thr Leu Arg Ser Asn Ile Ser Met Asn 330 335 340 | | | 1123 |

cat gag gac aac gtg cca att gat ccg cag gta att cgc gct tct ggt 1171
 His Glu Asp Asn Val Pro Ile Asp Pro Gln Val Ile Arg Ala Ser Gly
 345 350 355

ctg act gac atc att gag gtg gac gga ctt gat gcg ccg gtg cgc gat 1219
 Leu Thr Asp Ile Ile Glu Val Asp Gly Leu Asp Ala Pro Val Arg Asp
 360 365 370

acg gga agc aat tta tcg ggt ggg cag cgt cag cga gtg gct ttg gcc 1267
 Thr Gly Ser Asn Leu Ser Gly Gly Gln Arg Gln Arg Val Ala Leu Ala
 375 380 385

agg gcg ttg cat gca gac gcg gaa gta ctg gtg ctg atg gat cca acc 1315
 Arg Ala Leu His Ala Asp Ala Glu Val Leu Val Leu Met Asp Pro Thr
 390 395 400 405

agc gcg gtg gat tca gtg acg gag gtg tct atc gcg cag ggg att aag 1363
 Ser Ala Val Asp Ser Val Thr Glu Val Ser Ile Ala Gln Gly Ile Lys
 410 415 420

cag ctg cga gca ggc aaa acc acc att gtg gtg agt tct tcg ccc gcg 1411
 Gln Leu Arg Ala Gly Lys Thr Thr Ile Val Val Ser Ser Ser Pro Ala
 425 430 435

ttt tac aac ttg gcg gat ccg gtg att tca cat gtc taatttgatg 1457
 Phe Tyr Asn Leu Ala Asp Arg Val Ile Ser His Val
 440 445

gcatcatcga cac 1470

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<211> 449

<212> PRT

<213> Corynebacterium glutamicum

<400> 284

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Val Asp His Ala Val Leu Thr Lys Asp Leu Arg Arg Leu Val Val Gly
 20 25 30

Leu Val Ala Phe Val Val Leu Phe Val Val Leu Ser Phe Ser Asn Arg
 35 40 45

Phe Gly Ser Arg Ala Leu Asn Arg Ala Val Asn Phe Glu Ser His Ala
 50 55 60

Leu Arg Val Glu Val Ala Asp His Ala Leu Lys Asn Leu Asp Pro Arg
 65 70 75 80

Asn Leu Val Pro Gly Glu Val Met Ser Arg Ser Thr Ala Asp Ala Asp
 85 90 95

Ser Ser Thr Arg Ile Phe Gly Gln Ile Gly Thr Gly Val Ser Ala Ala

| 100 | | | | | 105 | | | | | 110 | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Thr | Gly | Phe | Leu | Gly | Ala | Ala | Thr | Tyr | Leu | Leu | Ile | Ser | Asp | Trp | Leu | |
| 115 | | | | | 120 | | | | | 125 | | | | | | |
| Val | Gly | Leu | Leu | Val | Leu | Val | Leu | Val | Pro | Ile | Ile | Ser | Gly | Val | Val | |
| 130 | | | | | 135 | | | | | 140 | | | | | | |
| Ala | Leu | Ala | Ser | Lys | Gly | Ile | Ser | Lys | Arg | Ser | Val | Thr | Gln | Gln | Glu | |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 | |
| Lys | Leu | Ala | Glu | Ser | Gly | Ala | Gln | Ala | Ser | Asp | Ile | Met | Met | Gly | Leu | |
| 165 | | | | | 170 | | | | | 175 | | | | | | |
| Arg | Val | Ile | Lys | Ala | Ile | Gly | Gly | Glu | Arg | Trp | Ala | Val | Lys | Thr | Phe | |
| 180 | | | | | 185 | | | | | 190 | | | | | | |
| Glu | Lys | Ala | Ser | Gln | Ala | Ser | Ala | Arg | Ala | Ala | Val | Asp | Thr | Ala | Val | |
| 195 | | | | | 200 | | | | | 205 | | | | | | |
| Ala | Ser | Gly | Lys | Val | Ala | Gly | Ile | Gly | Glu | Leu | Ser | Ile | Ala | Val | Asn | |
| 210 | | | | | 215 | | | | | 220 | | | | | | |
| Leu | Ala | Ala | Val | Leu | Leu | Leu | Ala | Gly | Trp | Arg | Val | Thr | Thr | Gly | Glu | |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 | |
| Leu | Gly | Pro | Gly | Gln | Leu | Ile | Ala | Ile | Val | Gly | Val | Ala | Val | Tyr | Leu | |
| 245 | | | | | 250 | | | | | 255 | | | | | | |
| Ser | Glu | Pro | Ile | Arg | Leu | Leu | Ser | Asn | Ser | Ile | Asn | Ala | Ser | Ala | Ile | |
| 260 | | | | | 265 | | | | | 270 | | | | | | |
| Ala | His | Gly | Ala | Ala | Glu | Arg | Val | Ala | Asn | Phe | Leu | Asn | Leu | Asp | Glu | |
| 275 | | | | | 280 | | | | | 285 | | | | | | |
| Ser | Gln | Ala | Gln | Tyr | Glu | Ser | Ser | Glu | Thr | Ile | Asn | Asp | Gly | Glu | Phe | |
| 290 | | | | | 295 | | | | | 300 | | | | | | |
| Leu | Val | Ile | Val | Pro | Pro | Ala | Ser | Thr | Leu | Pro | His | Gly | Asp | Asn | Ile | |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 | |
| Leu | Ala | Thr | Pro | His | Ala | Ala | Asp | Ile | Phe | Glu | Gly | Thr | Leu | Arg | Ser | |
| 325 | | | | | 330 | | | | | 335 | | | | | | |
| Asn | Ile | Ser | Met | Asn | His | Glu | Asp | Asn | Val | Pro | Ile | Asp | Pro | Gln | Val | |
| 340 | | | | | 345 | | | | | 350 | | | | | | |
| Ile | Arg | Ala | Ser | Gly | Leu | Thr | Asp | Ile | Ile | Glu | Val | Asp | Gly | Leu | Asp | |
| 355 | | | | | 360 | | | | | 365 | | | | | | |
| Ala | Pro | Val | Arg | Asp | Thr | Gly | Ser | Asn | Leu | Ser | Gly | Gly | Gln | Arg | Gln | |
| 370 | | | | | 375 | | | | | 380 | | | | | | |
| Arg | Val | Ala | Leu | Ala | Arg | Ala | Leu | His | Ala | Asp | Ala | Glu | Val | Leu | Val | |
| 385 | | | | | 390 | | | | | 395 | | | | | 400 | |
| Leu | Met | Asp | Pro | Thr | Ser | Ala | Val | Asp | Ser | Val | Thr | Glu | Val | Ser | Ile | |

| | | | | | |
|---|-----|--|-----|--|-----|
| | 405 | | 410 | | 415 |
| Ala Gln Gly Ile Lys Gln Leu Arg Ala Gly Lys Thr Thr Ile Val Val | | | | | |
| | 420 | | 425 | | 430 |
| Ser Ser Ser Pro Ala Phe Tyr Asn Leu Ala Asp Arg Val Ile Ser His | | | | | |
| | 435 | | 440 | | 445 |

Val

<210> 285
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 <223> RXN01102

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 Val Ala Val Leu Val
 1 5
 gcg gtt gca gca gcg ttc ggc agt tgg tca ctc ctt ctt ccc gtc gta 163
 Ala Val Ala Ala Ala Phe Gly Ser Trp Ser Leu Leu Leu Pro Val Val
 10 15 20
 ccg cta gcg gtc ctc aac aac ggc gga tca agc gct gtc gcc ggt gcc 211
 Pro Leu Ala Val Leu Asn Asn Gly Gly Ser Ser Ala Val Ala Gly Ala
 25 30 35
 acc act ggc atc ttc atg gca gct aca gtg atc act cag att ttc act 259
 Thr Thr Gly Ile Phe Met Ala Ala Thr Val Ile Thr Gln Ile Phe Thr
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 Pro Ala Ala Leu Arg Lys Ile Gly Tyr Thr Pro Val Met Ala Phe Ala
 55 60 65
 gca ttc atg ctg ggt gtg cca gcc atc ggg tac atc ttc agc gtc gag 355
 Ala Phe Met Leu Gly Val Pro Ala Ile Gly Tyr Ile Phe Ser Val Glu
 70 75 80 85
 cca att cca gtg ctg gta gtg tcc gca ctt cga gga att ggg ttc ggt 403
 Pro Ile Pro Val Leu Val Val Ser Ala Leu Arg Gly Ile Gly Phe Gly
 90 95 100
 gcg ctc acc gtc gca gaa tct gcg ttg gtg gct gaa ctc gtt ccc gta 451
 Ala Leu Thr Val Ala Glu Ser Ala Leu Val Ala Glu Leu Val Pro Val
 105 110 115

| | |
|---|------|
| cgc ttc ttg ggc aaa gct tct gga atg ttg ggc gta ttt att ggc ctt | 499 |
| Arg Phe Leu Gly Lys Ala Ser Gly Met Leu Gly Val Phe Ile Gly Leu | |
| 120 125 130 | |
| tcc caa atg ctt ttc ctg cct gcc ggg ttg gcg tta ggt gac caa ttt | 547 |
| Ser Gln Met Leu Phe Leu Pro Ala Gly Leu Ala Leu Gly Asp Gln Phe | |
| 135 140 145 | |
| ggc tac aac gtg gtc tat gtt tta ggt gcc gtt atc gca cta gtt gca | 595 |
| Gly Tyr Asn Val Val Tyr Val Leu Gly Ala Val Ile Ala Leu Val Ala | |
| 150 155 160 165 | |
| gcg gtg atg tgt ctg cgt att ccg cag gtt aag gca gcg gca aag cag | 643 |
| Ala Val Met Cys Leu Arg Ile Pro Gln Val Lys Ala Ala Ala Lys Gln | |
| 170 175 180 | |
| caa cca cag gtg agc gaa cag gag cgt tct gtt tcc acc tgg aag ttg | 691 |
| Gln Pro Gln Val Ser Glu Gln Glu Arg Ser Val Ser Thr Trp Lys Leu | |
| 185 190 195 | |
| gtg ctg gtt ccc tcc ttg gct gtt acc agt ttg tca atg act ttt ggc | 739 |
| Val Leu Val Pro Ser Leu Ala Val Thr Ser Leu Ser Met Thr Phe Gly | |
| 200 205 210 | |
| gca gtg tct tca ttc ctt cca gct gca gtc att gag tta gat cca gga | 787 |
| Ala Val Ser Ser Phe Leu Pro Ala Ala Val Ile Glu Leu Asp Pro Gly | |
| 215 220 225 | |
| tta ggt gct gca tta gcg ggt att att tta tcc att acc ggt ggt tct | 835 |
| Leu Gly Ala Ala Leu Ala Gly Ile Ile Leu Ser Ile Thr Gly Gly Ser | |
| 230 235 240 245 | |
| tca atg gtg ttc cgc tac ctg tcc ggc gtt atc gct gac cgc cgc ggt | 883 |
| Ser Met Val Phe Arg Tyr Leu Ser Gly Val Ile Ala Asp Arg Arg Gly | |
| 250 255 260 | |
| gtg cct ggt acc acg atg att cct gct cag atc att ggg ttc tta ggt | 931 |
| Val Pro Gly Thr Thr Met Ile Pro Ala Gln Ile Ile Gly Phe Leu Gly | |
| 265 270 275 | |
| gtc gtt tta atc acc gtc aca atc ttc caa ggc tgg tcc gtg tgg ctt | 979 |
| Val Val Leu Ile Thr Val Thr Ile Phe Gln Gly Trp Ser Val Trp Leu | |
| 280 285 290 | |
| ttg att ata ggt gca gtg atg ttt ggt ggt gct ttt ggc atg gtg caa | 1027 |
| Leu Ile Ile Gly Ala Val Met Phe Gly Gly Ala Phe Gly Met Val Gln | |
| 295 300 305 | |
| aac gaa gcg ttg ctt tca atg ttt ttc cgg ctt cct cgc act aga gtc | 1075 |
| Asn Glu Ala Leu Leu Ser Met Phe Phe Arg Leu Pro Arg Thr Arg Val | |
| 310 315 320 325 | |
| tcc gaa gcc tcc gcc atc tgg aat atc gcc ttt gat tcg gga aca gga | 1123 |
| Ser Glu Ala Ser Ala Ile Trp Asn Ile Ala Phe Asp Ser Gly Thr Gly | |
| 330 335 340 | |
| atc gga agc ttc ctc ctt ggc ata gtt gcc gca tcg ctt gct tac agt | 1171 |

Ile Gly Ser Phe Leu Leu Gly Ile Val Ala Ala Ser Leu Ala Tyr Ser
 345 350 355

ggt gct ttt ggt tcc gga gcc gtg gtg att ttg ttt gga atc gtt ttg 1219
 Gly Ala Phe Gly Ser Gly Ala Val Val Ile Leu Phe Gly Ile Val Leu
 360 365 370

acc acc gcc gat cga atc att ggg cgg cac cgc att act gaa tac aac 1267
 Thr Thr Ala Asp Arg Ile Ile Gly Arg His Arg Ile Thr Glu Tyr Asn
 375 380 385

aac acc cgc gcg cgt ttg cgc cag gtg cca gtc gct cgg cgt gca gtg 1315
 Asn Thr Arg Ala Arg Leu Arg Gln Val Pro Val Ala Arg Arg Ala Val
 390 395 400 405

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ccc 1368

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 35 40 45

Thr Gln Ile Phe Thr Pro Ala Ala Leu Arg Lys Ile Gly Tyr Thr Pro
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Val Met Ala Phe Ala Ala Phe Met Leu Gly Val Pro Ala Ile Gly Tyr
 65 70 75 80

Ile Phe Ser Val Glu Pro Ile Pro Val Leu Val Val Ser Ala Leu Arg
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Gly Ile Gly Phe Gly Ala Leu Thr Val Ala Glu Ser Ala Leu Val Ala
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Glu Leu Val Pro Val Arg Phe Leu Gly Lys Ala Ser Gly Met Leu Gly
 115 120 125

Val Phe Ile Gly Leu Ser Gln Met Leu Phe Leu Pro Ala Gly Leu Ala
 130 135 140

Leu Gly Asp Gln Phe Gly Tyr Asn Val Val Tyr Val Leu Gly Ala Val
 145 150 155 160

Ile Ala Leu Val Ala Ala Val Met Cys Leu Arg Ile Pro Gln Val Lys
 165 170 175
 Ala Ala Ala Lys Gln Gln Pro Gln Val Ser Glu Gln Glu Arg Ser Val
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 Ser Met Thr Phe Gly Ala Val Ser Ser Phe Leu Pro Ala Ala Val Ile
 210 215 220
 Glu Leu Asp Pro Gly Leu Gly Ala Ala Leu Ala Gly Ile Ile Leu Ser
 225 230 235 240
 Ile Thr Gly Gly Ser Ser Met Val Phe Arg Tyr Leu Ser Gly Val Ile
 245 250 255
 Ala Asp Arg Arg Gly Val Pro Gly Thr Thr Met Ile Pro Ala Gln Ile
 260 265 270
 Ile Gly Phe Leu Gly Val Val Leu Ile Thr Val Thr Ile Phe Gln Gly
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 Trp Ser Val Trp Leu Leu Ile Ile Gly Ala Val Met Phe Gly Gly Ala
 290 295 300
 Phe Gly Met Val Gln Asn Glu Ala Leu Leu Ser Met Phe Phe Arg Leu
 305 310 315 320
 Pro Arg Thr Arg Val Ser Glu Ala Ser Ala Ile Trp Asn Ile Ala Phe
 325 330 335
 Asp Ser Gly Thr Gly Ile Gly Ser Phe Leu Leu Gly Ile Val Ala Ala
 340 345 350
 Ser Leu Ala Tyr Ser Gly Ala Phe Gly Ser Gly Ala Val Val Ile Leu
 355 360 365
 Phe Gly Ile Val Leu Thr Thr Ala Asp Arg Ile Ile Gly Arg His Arg
 370 375 380
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<212> DNA

<213> Corynebacterium glutamicum

<220>

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<222> (101)..(325)

<223> RXN00788

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| ttgatccagc | actgcttgca | gtgaggcctc | attagttggc | atg | gcc | tcc | tcc | atc | 115 |
| | | | | Met | Ala | Ser | Ser | Ile | |
| | | | | 1 | | | | 5 | |

| | | | | | | | | | | | | | | | | |
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| aac | atc | gga | gtg | ttc | aac | ctt | gga | aat | gct | gtt | gct | gcc | tgg | ctt | gct | 163 |
| Asn | Ile | Gly | Val | Phe | Asn | Leu | Gly | Asn | Ala | Val | Ala | Ala | Trp | Leu | Ala | |
| | | | 10 | | | | | 15 | | | | | | 20 | | |

| | | | | | | | | | | | | | | | | |
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| ggt | gca | acc | atc | acc | act | tcc | ctt | gga | ctc | aca | tca | gcc | gga | tta | gtt | 211 |
| Gly | Ala | Thr | Ile | Thr | Thr | Ser | Leu | Gly | Leu | Thr | Ser | Ala | Gly | Leu | Val | |
| | | | 25 | | | | | 30 | | | | | 35 | | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| ggc | ggt | ttg | atg | acg | tcc | ctc | gga | cta | gtg | ttg | gcc | atc | gtg | gct | gtg | 259 |
| Gly | Gly | Leu | Met | Thr | Ser | Leu | Gly | Leu | Val | Leu | Ala | Ile | Val | Ala | Val | |
| | | 40 | | | | | 45 | | | | | 50 | | | | |

| | | | | | | | | | | | | | | | | |
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| gtt | ttg | cgt | cga | aaa | gcg | caa | ggc | acc | caa | gcg | acc | atc | agc | gtt | gtg | 307 |
| Val | Leu | Arg | Arg | Lys | Ala | Gln | Gly | Thr | Gln | Ala | Thr | Ile | Ser | Val | Val | |
| | | 55 | | | | 60 | | | | | 65 | | | | | |

| | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|------------|------------|-----|-----|
| gag | cac | cag | ccc | gcc | caa | taaataattt | ctctcttcta | att | 348 |
| Glu | His | Gln | Pro | Ala | Gln | | | | |
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<213> Corynebacterium glutamicum

<400> 288

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| Met | Ala | Ser | Ser | Ile | Asn | Ile | Gly | Val | Phe | Asn | Leu | Gly | Asn | Ala | Val |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Ala | Trp | Leu | Ala | Gly | Ala | Thr | Ile | Thr | Thr | Ser | Leu | Gly | Leu | Thr |
| | | | 20 | | | | | 25 | | | | | 30 | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ser | Ala | Gly | Leu | Val | Gly | Gly | Leu | Met | Thr | Ser | Leu | Gly | Leu | Val | Leu |
| | | 35 | | | | | 40 | | | | | 45 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Ile | Val | Ala | Val | Val | Leu | Arg | Arg | Lys | Ala | Gln | Gly | Thr | Gln | Ala |
| | 50 | | | | | 55 | | | | | 60 | | | | |

| | | | | | | | | | | |
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| Thr | Ile | Ser | Val | Val | Glu | His | Gln | Pro | Ala | Gln |
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 Met Thr Glu Thr Leu
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gtg gtg aat ggc ctt gca ggc ggc tat ggg cac cgc aca tta ttt aac 163
 Val Val Asn Gly Leu Ala Gly Gly Tyr Gly His Arg Thr Leu Phe Asn
 10 15 20

gat gtg aat ctc acc gta gct gcc ggc gat gtc gtg ggc gtt gtc ggc 211
 Asp Val Asn Leu Thr Val Ala Ala Gly Asp Val Val Gly Val Val Gly
 25 30 35

gtc aat ggc gct ggt aaa tcc aca ttt cta aaa att ctg gcg ggc gtg 259
 Val Asn Gly Ala Gly Lys Ser Thr Phe Leu Lys Ile Leu Ala Gly Val
 40 45 50

gaa aag cca ctg gct gga act atc gcg ctt tcg cca gcc gat gct ttt 307
 Glu Lys Pro Leu Ala Gly Thr Ile Ala Leu Ser Pro Ala Asp Ala Phe
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gtg ggc tac ttg cca cag gaa cac acc cgc acg tct gga gag acg atc 355
 Val Gly Tyr Leu Pro Gln Glu His Thr Arg Thr Ser Gly Glu Thr Ile
 70 75 80 85

gca gtt tac att gct cgt cga acc ggc tgc caa gct gca aca act gcc 403
 Ala Val Tyr Ile Ala Arg Arg Thr Gly Cys Gln Ala Ala Thr Thr Ala
 90 95 100

atg gat gac acc gcc gaa gcg ttt ggt gcg gat cca gac aac gct gcc 451
 Met Asp Asp Thr Ala Glu Ala Phe Gly Ala Asp Pro Asp Asn Ala Ala
 105 110 115

ttg gcc gat gca tac gcc gag gcg ctg gat cgg tgg atg gcc agt ggc 499
 Leu Ala Asp Ala Tyr Ala Glu Ala Leu Asp Arg Trp Met Ala Ser Gly
 120 125 130

gca gcc gat ttg gat gaa cgc atc ccc atc gtg ctc gct gat ttg ggc 547
 Ala Ala Asp Leu Asp Glu Arg Ile Pro Ile Val Leu Ala Asp Leu Gly
 135 140 145

ttt gag ctt ccc acc tcg acg ctg atg gaa gga ctt tca ggc ggc cag 595
 Phe Glu Leu Pro Thr Ser Thr Leu Met Glu Gly Leu Ser Gly Gly Gln
 150 155 160 165

gca gcc cgg gtc ggg ctg gcg gcg tta ctg ttg tca cgt ttt gac att 643
 Ala Ala Arg Val Gly Leu Ala Ala Leu Leu Leu Ser Arg Phe Asp Ile
 170 175 180

| | |
|---|------|
| gtg ctt ctc gac gag ccc acc aac gat ttg gat ctc gac ggt ctt gag | 691 |
| Val Leu Leu Asp Glu Pro Thr Asn Asp Leu Asp Leu Asp Gly Leu Glu | |
| 185 190 195 | |
| caa ctg gag aat ttt gtt cag ggg ctt cgc ggg gga gtc gta ctg gtc | 739 |
| Gln Leu Glu Asn Phe Val Gln Gly Leu Arg Gly Gly Val Val Leu Val | |
| 200 205 210 | |
| agc cat gat cgt gag ttt ctt tcc agg tgt gtg acc act gtg ctg gaa | 787 |
| Ser His Asp Arg Glu Phe Leu Ser Arg Cys Val Thr Thr Val Leu Glu | |
| 215 220 225 | |
| ctc gat ctg cac caa aat tcc cac cat gtt tat ggc ggt gga tat gat | 835 |
| Leu Asp Leu His Gln Asn Ser His His Val Tyr Gly Gly Gly Tyr Asp | |
| 230 235 240 245 | |
| tcc tac ctt gag gaa cgc gca gtg cta cgc cag cac gcc cgt gac caa | 883 |
| Ser Tyr Leu Glu Glu Arg Ala Val Leu Arg Gln His Ala Arg Asp Gln | |
| 250 255 260 | |
| tat gag gaa ttt gcg gaa aag aag aag gac ctt gtg gca cgt gct cga | 931 |
| Tyr Glu Glu Phe Ala Glu Lys Lys Lys Asp Leu Val Ala Arg Ala Arg | |
| 265 270 275 | |
| acg cag cgt gaa tgg tct agt cac ggt gtc cgc aat gct att aaa cgt | 979 |
| Thr Gln Arg Glu Trp Ser Ser His Gly Val Arg Asn Ala Ile Lys Arg | |
| 280 285 290 | |
| gca cct gac aac gac aaa ctt cgg aag aaa gcc gct gcg gaa tcc agt | 1027 |
| Ala Pro Asp Asn Asp Lys Leu Arg Lys Lys Ala Ala Ala Glu Ser Ser | |
| 295 300 305 | |
| gaa aag cag gct caa aaa gtc cgc cag atg gaa agc cgc atc gct cgg | 1075 |
| Glu Lys Gln Ala Gln Lys Val Arg Gln Met Glu Ser Arg Ile Ala Arg | |
| 310 315 320 325 | |
| tta gaa gaa gtt gaa gag cca cgt aaa gaa tgg aaa ctg cag ttc agc | 1123 |
| Leu Glu Glu Val Glu Glu Pro Arg Lys Glu Trp Lys Leu Gln Phe Ser | |
| 330 335 340 | |
| gtc ggt aag gcg tcg cgg tca agt tct gtt gtt tcc acg ttg aat gat | 1171 |
| Val Gly Lys Ala Ser Arg Ser Ser Ser Val Val Ser Thr Leu Asn Asp | |
| 345 350 355 | |
| gca agc ttc acc caa ggc gat ttc acc ttg gga cca gta tcc atc caa | 1219 |
| Ala Ser Phe Thr Gln Gly Asp Phe Thr Leu Gly Pro Val Ser Ile Gln | |
| 360 365 370 | |
| gta aat gct ggc gat cgc att ggc atc aca gga ccc aac ggt gct ggt | 1267 |
| Val Asn Ala Gly Asp Arg Ile Gly Ile Thr Gly Pro Asn Gly Ala Gly | |
| 375 380 385 | |
| aaa tcc aca ttg ctg cgc gga cta ttg gga aac caa gaa ccc acc agc | 1315 |
| Lys Ser Thr Leu Leu Arg Gly Leu Leu Gly Asn Gln Glu Pro Thr Ser | |
| 390 395 400 405 | |
| ggg act gcc acg atg ggc acg agc gtg gcg atc gga gaa atc gat cag | 1363 |

Gly Thr Ala Thr Met Gly Thr Ser Val Ala Ile Gly Glu Ile Asp Gln
 410 415 420

gca cga gcg tta ctt gat cca cag ttg cca ctg att tct gcg ttt gaa 1411
 Ala Arg Ala Leu Leu Asp Pro Gln Leu Pro Leu Ile Ser Ala Phe Glu
 425 430 435

aag cat gtt cca gac tta ccg atc agt gag gtg cgc aca ctg ctc gcg 1459
 Lys His Val Pro Asp Leu Pro Ile Ser Glu Val Arg Thr Leu Leu Ala
 440 445 450

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 Lys Phe Gly Leu Asn Asp Asn His Val Glu Arg Asp Val Glu Lys Leu
 455 460 465

tct cct ggc gag cgc acg cgc gcc gga ctt gcg ctg cta cag gtg cgg 1555
 Ser Pro Gly Glu Arg Thr Arg Ala Gly Leu Ala Leu Leu Gln Val Arg
 470 475 480 485

ggc gtc aac gtg ctt gtt ctt gat gag ccc acc aac cac ctt gac ctg 1603
 Gly Val Asn Val Leu Val Leu Asp Glu Pro Thr Asn His Leu Asp Leu
 490 495 500

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 Glu Ala Ile Glu Gln Leu Glu Gln Ala Leu Ala Ser Tyr Asp Gly Val
 505 510 515

ttg ctg ctg gtc acg cac gat cgt cgc atg ttg gac gct gtg cag acc 1699
 Leu Leu Leu Val Thr His Asp Arg Met Leu Asp Ala Val Gln Thr
 520 525 530

aat cgt cgt tgg cat gtc gag gct ggc gaa gtt agg gag cta 1741
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Ile Leu Ala Gly Val Glu Lys Pro Leu Ala Gly Thr Ile Ala Leu Ser
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Pro Ala Asp Ala Phe Val Gly Tyr Leu Pro Gln Glu His Thr Arg Thr

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| Ser Gly Glu Thr Ile Ala Val Tyr Ile Ala Arg Arg Thr Gly Cys Gln | 85 | 90 | 95 |
| Ala Ala Thr Thr Ala Met Asp Asp Thr Ala Glu Ala Phe Gly Ala Asp | 100 | 105 | 110 |
| Pro Asp Asn Ala Ala Leu Ala Asp Ala Tyr Ala Glu Ala Leu Asp Arg | 115 | 120 | 125 |
| Trp Met Ala Ser Gly Ala Ala Asp Leu Asp Glu Arg Ile Pro Ile Val | 130 | 135 | 140 |
| Leu Ala Asp Leu Gly Phe Glu Leu Pro Thr Ser Thr Leu Met Glu Gly | 145 | 150 | 155 |
| Leu Ser Gly Gly Gln Ala Ala Arg Val Gly Leu Ala Ala Leu Leu Leu | 165 | 170 | 175 |
| Ser Arg Phe Asp Ile Val Leu Leu Asp Glu Pro Thr Asn Asp Leu Asp | 180 | 185 | 190 |
| Leu Asp Gly Leu Glu Gln Leu Glu Asn Phe Val Gln Gly Leu Arg Gly | 195 | 200 | 205 |
| Gly Val Val Leu Val Ser His Asp Arg Glu Phe Leu Ser Arg Cys Val | 210 | 215 | 220 |
| Thr Thr Val Leu Glu Leu Asp Leu His Gln Asn Ser His His Val Tyr | 225 | 230 | 235 |
| Gly Gly Gly Tyr Asp Ser Tyr Leu Glu Glu Arg Ala Val Leu Arg Gln | 245 | 250 | 255 |
| His Ala Arg Asp Gln Tyr Glu Glu Phe Ala Glu Lys Lys Lys Asp Leu | 260 | 265 | 270 |
| Val Ala Arg Ala Arg Thr Gln Arg Glu Trp Ser Ser His Gly Val Arg | 275 | 280 | 285 |
| Asn Ala Ile Lys Arg Ala Pro Asp Asn Asp Lys Leu Arg Lys Lys Ala | 290 | 295 | 300 |
| Ala Ala Glu Ser Ser Glu Lys Gln Ala Gln Lys Val Arg Gln Met Glu | 305 | 310 | 315 |
| Ser Arg Ile Ala Arg Leu Glu Glu Val Glu Glu Pro Arg Lys Glu Trp | 325 | 330 | 335 |
| Lys Leu Gln Phe Ser Val Gly Lys Ala Ser Arg Ser Ser Ser Val Val | 340 | 345 | 350 |
| Ser Thr Leu Asn Asp Ala Ser Phe Thr Gln Gly Asp Phe Thr Leu Gly | 355 | 360 | 365 |
| Pro Val Ser Ile Gln Val Asn Ala Gly Asp Arg Ile Gly Ile Thr Gly | | | |

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                               Val Thr Ser Asp Ser
                               1                               5

ccc gcg cca gca acc gtc aac gcg gta ttc aac aac agc aac ggc ttc 163
Pro Ala Pro Ala Thr Val Asn Ala Val Phe Asn Asn Ser Asn Gly Phe
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| | |
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| atg gac acg gaa ttc ggc gtc cgc att gtg gat aac atg ctc gtc ggt | 259 |
| Met Asp Thr Glu Phe Gly Val Arg Ile Val Asp Asn Met Leu Val Gly | |
| 40 45 50 | |
| ttc tcc acc ttg ggc gac ggc atg aac caa gcc gcc gaa ggt gcc act | 307 |
| Phe Ser Thr Leu Gly Asp Gly Met Asn Gln Ala Ala Glu Gly Ala Thr | |
| 55 60 65 | |
| acg ctc agc gat ggc gtc ggt tcc gcc aac gac ggt gca gtt cag ctt | 355 |
| Thr Leu Ser Asp Gly Val Gly Ser Ala Asn Asp Gly Ala Val Gln Leu | |
| 70 75 80 85 | |
| gcc gac ggc gcg gtc acc ctg cgc gac ggc atc gca agt gcc aat gag | 403 |
| Ala Asp Gly Ala Val Thr Leu Arg Asp Gly Ile Ala Ser Ala Asn Glu | |
| 90 95 100 | |
| ggt gcg caa tcg ctt gcc gac ggc gcc agc cag ctc gac acc ggc ctc | 451 |
| Gly Ala Gln Ser Leu Ala Asp Gly Ala Ser Gln Leu Asp Thr Gly Leu | |
| 105 110 115 | |
| ggc tcc gcg gct aca ggc agc caa acg ctc gcc gac ggt cta tcc agc | 499 |
| Gly Ser Ala Ala Thr Gly Ser Gln Thr Leu Ala Asp Gly Leu Ser Ser | |
| 120 125 130 | |
| ctg tct gcg ggc acc gcc caa cta ggc caa ggc gca acc cag gtt tca | 547 |
| Leu Ser Ala Gly Thr Ala Gln Leu Gly Gln Gly Ala Thr Gln Val Ser | |
| 135 140 145 | |
| gat ggc gtg ggc caa ctt gtc gac caa gta gca cca ctg acc gcc tat | 595 |
| Asp Gly Val Gly Gln Leu Val Asp Gln Val Ala Pro Leu Thr Ala Tyr | |
| 150 155 160 165 | |
| gtt cca gac atc aac tct cag ttg atc acc ctg cgc gac ggc gca gcc | 643 |
| Val Pro Asp Ile Asn Ser Gln Leu Ile Thr Leu Arg Asp Gly Ala Ala | |
| 170 175 180 | |
| acc att gcc tct gaa cta tct gat ccc tcc agc acc tac cgc tcc ggc | 691 |
| Thr Ile Ala Ser Glu Leu Ser Asp Pro Ser Ser Thr Tyr Arg Ser Gly | |
| 185 190 195 | |
| gtg gac tcc gct gtg agc gca tcc cag caa cta gca gcc ggc ctg caa | 739 |
| Val Asp Ser Ala Val Ser Ala Ser Gln Gln Leu Ala Ala Gly Leu Gln | |
| 200 205 210 | |
| acc ctg aaa gac gga tcc agc caa ctc agc atc ggt gca cgc acc ctc | 787 |
| Thr Leu Lys Asp Gly Ser Ser Gln Leu Ser Ile Gly Ala Arg Thr Leu | |
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| Ile | Trp | Val | Leu | Leu | Phe | Ile | Trp | Ala | Leu | Met | Leu | Ala | Ile | Ser | Thr | |

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| Val Ala Ile Ser Trp Val Phe Ile Ser Ile Thr His Met Phe Asn Asn 385 390 395 400 | | |
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BGI-124CPPC - 97 -

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| 199 41 382.7 | 31 August 1999 (31.08.1999) | DE |

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Biotechnology, Anam Dong, Sungbook-Gu, Seoul
136-701 (KR).

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HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR,
LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,
NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,
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patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
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Published:

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CORYNEBACTERIUM GLUTAMICUM GENES ENCODING STRESS, RESISTANCE AND TOLERANCE PROTEINS

(57) Abstract: Isolated nucleic acid molecules, designated SRT nucleic acid molecules, which encode novel SRT proteins from *Corynebacterium glutamicum* are described. The invention also provides antisense nucleic acid molecules, recombinant expression vectors containing SRT nucleic acid molecules, and host cells into which the expression vectors have been introduced. The invention still further provides isolated SRT proteins, mutated SRT proteins, fusion proteins, antigenic peptides and methods for the improvement of production of a desired compound from *C. glutamicum* based on genetic engineering of SRT genes in this organism.



WO 01/00804 A3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 00/00922

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C12N15/31 C12N1/21 C12Q1/68 C07K14/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C07K C12N C12Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, BIOSIS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|-----------------------|
| X | DATABASE EBI [Online] AC X13385, 19 March 1999 (1999-03-19) BARASH S. ET AL.: "Enterococcus faecalis genome contig" XP002152527 abstract | 6,8 |
| X | --- JAEGER WOLFGANG ET AL: "A Corynebacterium glutamicum gene conferring multidrug resistance in the heterologous host Escherichia coli." JOURNAL OF BACTERIOLOGY, vol. 179, no. 7, 1997, pages 2449-2451, XP002152524 ISSN: 0021-9193 the whole document --- -/-- | 1,2, 8-19,22 |

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☒ Patent family members are listed in annex.

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- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

14 November 2000

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Fax: (+31-70) 340-3016

Authorized officer

Kania, T

INTERNATIONAL SEARCH REPORT

Int. Application No
PCT/IB 00/00922

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|----------|--|--------------------------------------|
| X | WEHRMANN AXEL ET AL: "Different modes of diaminopimelate synthesis and their role in cell wall integrity: A study with <i>Corynebacterium glutamicum</i> ." JOURNAL OF BACTERIOLOGY, vol. 180, no. 12, June 1998 (1998-06), pages 3159-3165, XP002152525 ISSN: 0021-9193 cited in the application the whole document | 1,2,8, 19,22 |
| X | PETER H ET AL: "CORYNEBACTERIUM GLUTAMICUM IS EQUIPPED WITH FOUR SECONDARY CARRIERS FOR COMPATIBLE SOLUTES: IDENTIFICATION, SEQUENCING, AND CHARACTERIZATION OF THE PROLINE/ECTOINE UPTAKE SYSTEM, PROP, AND THE ECTOINE/PROLINE/GLYCINE BETAINES CARRIER, ECTP" JOURNAL OF BACTERIOLOGY, WASHINGTON, DC, US, vol. 180, no. 22, 1998, pages 6005-6012, XP000917352 ISSN: 0021-9193 the whole document | 1,2, 8-19,22 |
| X | CHAN MING-SHUN ET AL: "Cloning of m-fluorophenylalanine-resistant gene and mutational analysis of feedback-resistant prephenate dehydratase from <i>Corynebacterium glutamicum</i> ." BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS, vol. 219, no. 2, 1996, pages 537-542, XP002152526 ISSN: 0006-291X the whole document | 1,2, 8-19,22 |
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| X | WO 99 02692 A (YAGOSHI CHIZU ;AJINOMOTO KK JP); KIMURA EIICHIRO (JP); NAKAMURA J) 21 January 1999 (1999-01-21) the whole document & EP 1 002 866 A (AJINOMOTO KK) 24 May 2000 (2000-05-24) | 1,2, 8-19,22, 25-34 |
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| A | FR 2 607 827 A (PASTEUR INSTITUT) 10 June 1988 (1988-06-10) the whole document --- | 1-38 |
| A | EP 0 252 558 A (SCLAVO SPA) 13 January 1988 (1988-01-13) the whole document --- | 35 |
| P,X | DATABASE EBI [Online] AC AF237667, 14 March 2000 (2000-03-14) KIM H. AND LEE H.: "Nucleotide sequence of the lmrB gene in Corynebacterium glutamicum" XP002152528 abstract ----- | 1-24 |

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national application No.
PCT/IB 00/00922

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-38 partially

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: invention 1: claims 1-38 partially

An isolated nucleic acid molecule from *Corynebacterium glutamicum* encoding a stress, resistance, or tolerance gene disclaiming the F-designated genes in table 1. Said gene having the SEQ ID NO:1, homologs (at least 50% homology), variants, and DNA sequences hybridizing thereto, as well as vectors and host cells comprising said sequences. An isolated stress, resistance, or tolerance polypeptide from *C. glutamicum*. Said protein having the SEQ ID NO:2, homologs (at least 50% homology), and variants thereof. The use of said sequences to modify the production of or produce a fine chemical from said host cell, the fine chemical especially being an amino acid. A method for diagnosing the presence or activity of *Corynebacterium diphtheriae* in a subject employing said sequences. A host cell comprising said nucleic acid sequences wherein said sequences are disrupted modified, or under the control of a heterologous regulatory region.

2. Claims: inventions 2-122: claims 1-38 partially

as invention 1 but relating to the pairs of sequences as listed in Table 1 (apart from the ones disclaimed)

INTERNATIONAL SEARCH REPORT

...formation on patent family members

Int. Application No

PCT/IB 00/00922

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
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